JULY, 19

RAILWAY Mechanical and Electrical Engineer

UNTIL SOMETHING BETTER COMES ALONG

NO PROGRESSIVE RAILROAD CAN OVERLOOK

ITS PROVEN SAFETY AND DEPENDABILITY...

TRUCK

JULY, 1950

RAILWAY Mechanical and Electrical Engineer

Founded in 1832 as the American Rail-Road Journal.

VOLUME 124 No. 7

FEATURE:

ELECTRICAL SECTION:

EDITORIALS:

CAR INSPECTION AND REPAIR:

QUESTIONS AND ANSWERS:

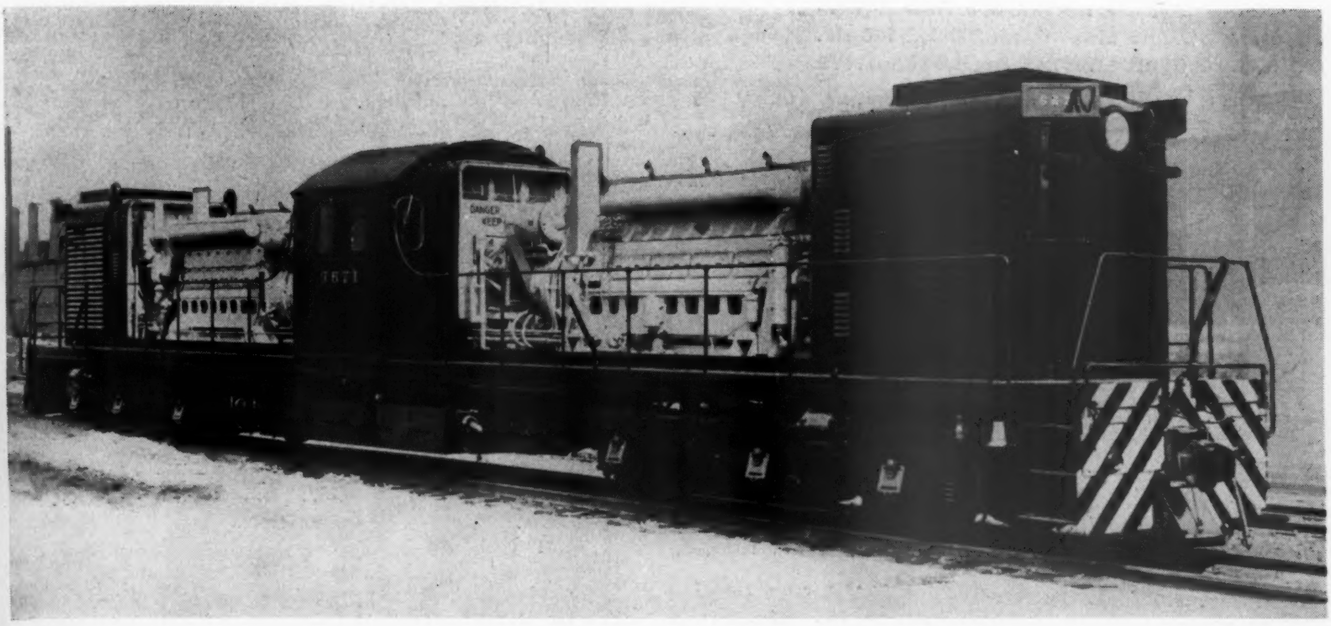
NEW DEVICES:

Published monthly by Simmons-Boardman Publishing Corporation
1309 Noble street, Philadelphia, Pa. Editorial and executive offices: 30 Church street, New York 7, and 79 W. Monroe street, Chicago 3. Branch offices: Terminal Tower, Cleveland 13; 1081 National Press bldg., Washington 4, D.C.; 1914 Minor avenue, Seattle 1, Wash.; 816 W. Fifth street, Los Angeles 13, Calif.; 2909 Maple avenue, Dallas 4, Tex.

The Railway Mechanical and Electrical Engineer is a member of the Associated Business Papers (A.B.P.) and the Audit Bureau of Circulations (A.B.C.) and is indexed by the Industrial Arts Index and also by the Engineering Index Service. Printed in U. S. A.

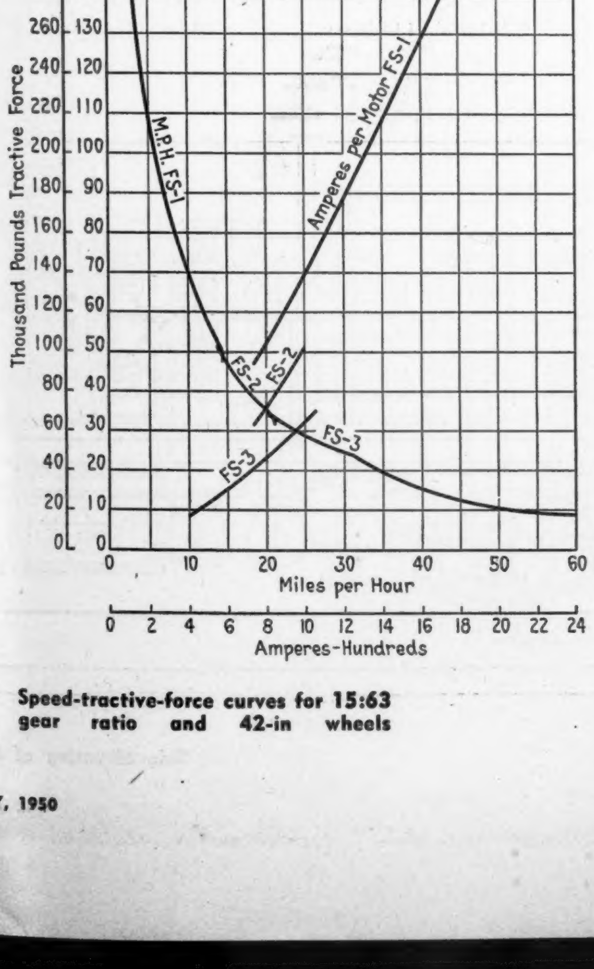
Subscriptions payable in advance and postage free. United States, U. S. Possessions and Canada, 1 year, $3. Other countries in Western Hemisphere: 1 year, $5; 2 years, $8. All other countries: 1 year, $7; 2 years, $12. Single copies 50 cents. Address H. E. McCandless, circulation manager, 30 Church street, New York 7.

PRINTED BY PERIODICAL PRESS CORP., PHILA. 23, PA.



Pennsylvania 2,500 Hp. Switcher

Lima-Hamilton delivers the first of eleven transfer locomotives with 108,000-lb tractive force and 360,000-lb. total weight



Speed-tractive-force curves for 15:63 gear ratio and 42-in wheels

Lima-Hamilton Corporation, from its Lima Locomotive Works Division at Lima, Ohio, has delivered to the Pennsylvania the first of eleven 2,500-hp. Diesel-electric transfer locomotives on order for that road. At the same time, Lima-Hamilton announced that, in addition to its 800- and 1,200-hp. switchers, it has added a 2,400-hp. unit to its standard line. This latter locomotive is similar in many respects to the 2,500-hp. design.

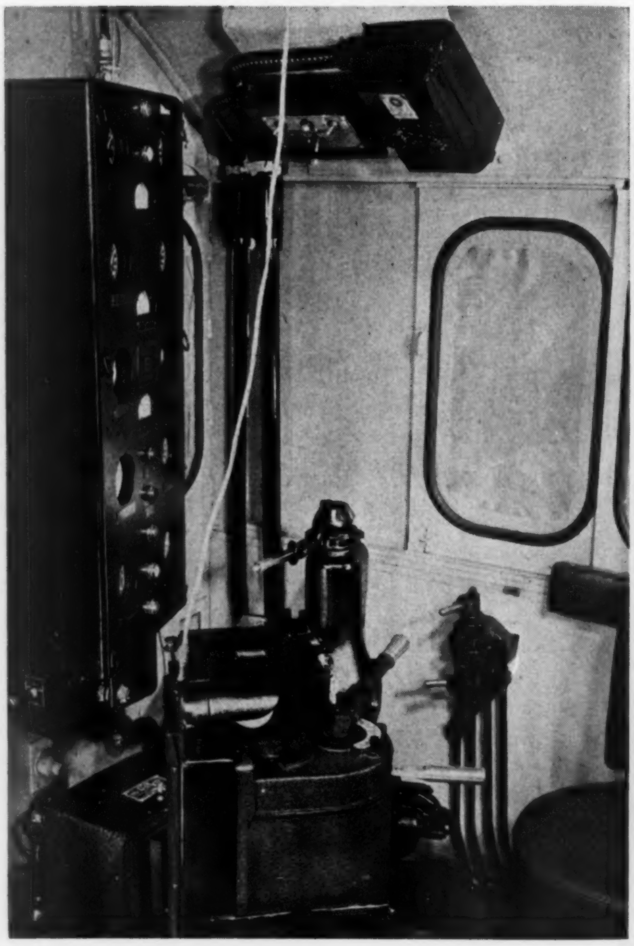
Of the steeple cab type, the 2,500-hp. unit is of the C-C wheel arrangement, with a single cab mounted on the frame which is carried on two six-wheel side-equalized swivel trucks having a motor on each axle. The operator's compartment is located at the center of the locomotive, with a power plant hood extending to each end of the unit. The rating of 2,500-hp. is the combined brake horsepower of the two engines.

The locomotive is powered by two Lima-Hamilton 9-in. by 12-in. vertical eight-cylinder Diesel engines of the four-cycle, single-acting, pressure-charged type. Each of these engines develops a full 1,250 b.hp. The locomotive, which weighs 180 tons in working order, has a maximum speed of 65 m.p.h.

The starting tractive force of the locomotive (30 per cent adhesion) is 108,000 lb. The maximum height to the top of the cab is 14 ft. 6 in., while the maximum width over brake cylinders is 10 ft. 2⅛ in., and over hand rails is 9 ft. 11⅛ in. The length inside coupler knuckles is 79 ft.; the distance between truck centers is 49 ft. 0 in.; the truck wheel base is 13 ft. and the total wheel base, 61 ft. 3 in. The diameter is 42 in. The various capacities are as follows: fuel oil, 1,250 gal.; cooling water, 450 gal.; lubricating oil, 290 gal.

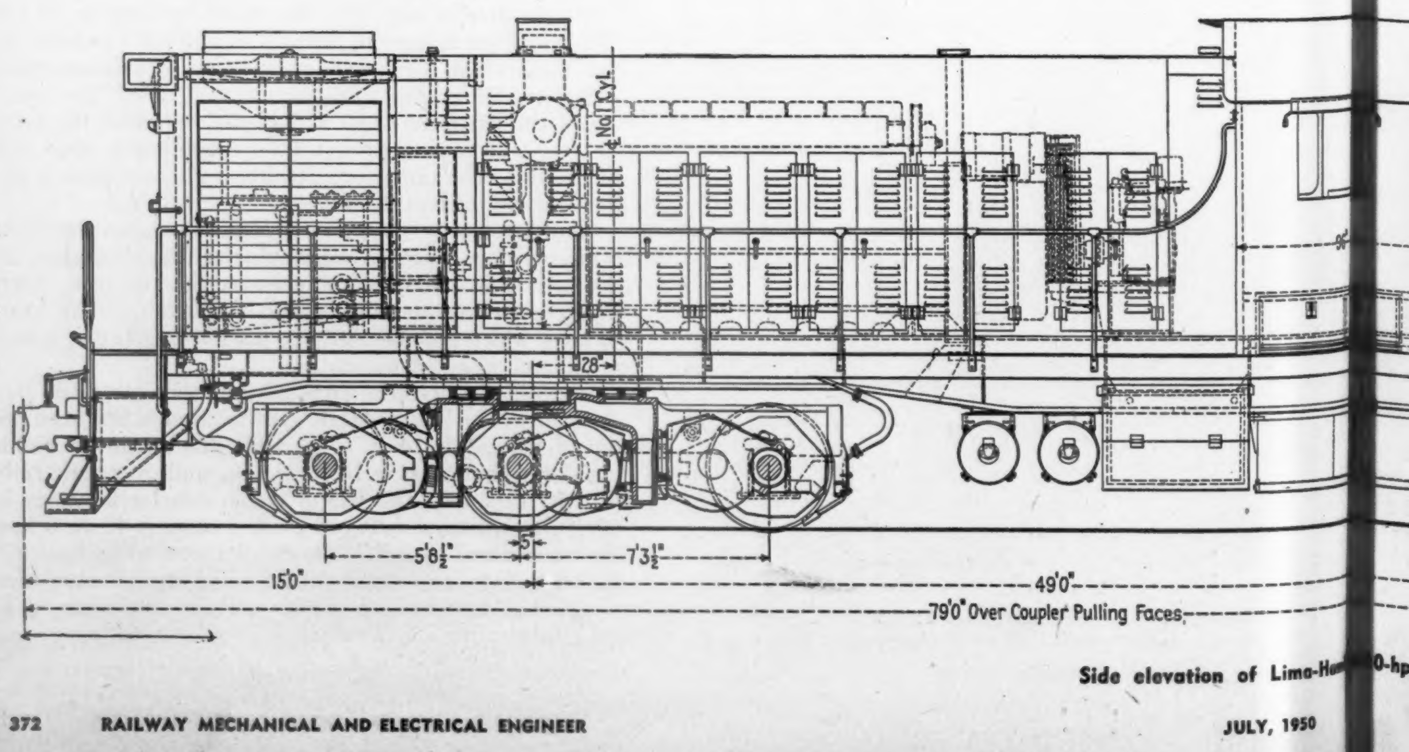
PARTIAL LIST OF MATERIALS AND EQUIPMENT FOR THE LIMA-HAMILTON 2,500-HP. DIESEL-ELECTRIC TRANSFER LOCOMOTIVE

Boxes, truck, with lids	Balmar Corp., Baltimore, Md.
Couplers, rubber draft gears and draft yokes	National Malleable & Steel Castings Co., Cleveland, Ohio
Coupling, Steel Flex	Falk Corp., Milwaukee, Wis.
Motor trucks	General Steel Castings Corp., Granite City, Ill.
Wheels	Armco Steel Corp., Middletown, Ohio Bethlehem Steel Co., Bethlehem, Pa.
Air brake, air compressor and foundation brake	Westinghouse Air Brake Co., Wilmerding, Pa.
Handbrake	National Brake Co., New York
Diesel engines, 9-in. by 12-in.	Lima-Hamilton Corp., Lima, Ohio
Turbo-charger	Elliott Co., Jeannette, Pa.
Governor	Woodward Governor Co., Rockford, Ill.
Electrical equipment	Westinghouse Electric Corp., Pittsburgh, Pa.
Connectors, motor cable clasp	Burndy Engineering Co., New York
Blowers, traction motor	Buffalo Forge Co., Buffalo, N. Y.
Batteries	Electric Storage Battery Co., Philadelphia, Pa.
Water temperature operated switch and control sleeve	Detroit Lubricator Co., Detroit, Mich.
Water tank gage	O. C. Keckley Co., Chicago
Cab ventilator	Prime Manufacturing Co., Milwaukee, Wis.
Valve, back press	Klipfel Valves, Inc., Hamilton, Ohio
Air-filter silencer	Air Maze Corp., Cleveland, Ohio
Air-filter panels	Farr Co., Los Angeles, Cal.
Air-intake manifold pressure and temperature indicator gages	Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Fan assembly, radiator cooling, 60-in.	International Engineering, Inc., Dayton, Ohio
Hot-water heater; radiator shutter assembly, R & L	Kysor Heater Co., Cadillac, Mich.
Radiators; heat exchangers	Young Radiator Co., Racine, Wis.
Valve, shut-off, emergency fuel	Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Pump, fuel oil	Viking Pump Co., Cedar Falls, Iowa
Filter, lubricating oil (pressure line) and fuel oil	W. W. Nugent & Co., Chicago
Filter, lubricating and fuel oil	Michiana Products Corp., Michigan City, Ind.
Gage, lubricating oil pressure	Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Gages, fuel oil tank level	Nathan Manufacturing Co., New York
Gage, lubricating oil tank	O. C. Keckley Co., Chicago
Bell ringer	Viloco Railway Equipment Co., Chicago
Windshield wipers	Sprague Devices Co., Chas. A., Michigan City, Ind.
Doors, cab, front and rear	Met-L-Wood Corp., Chicago
Cab door locks; hood door latches	Adams & Westlake Co., Elkhart, Ind.
Footboards	Apex Railway Products Co., Chicago
Side step treads	Blaw-Knox Co., Pittsburgh, Pa.
Headlight; number lightboxes	Pyle-National Co., Chicago
Sun visors	Fulton Co., Milwaukee, Wis.
Inspection card holders	Adams & Westlake Co., Elkhart, Ind.
Marker lights	Lovell-Dressel Co., Arlington, N. J.
Vent, grid type, with weather cap	Protectoseal Co., Chicago
Pneuphonic horn	Westinghouse Air Brake Co., Wilmerding, Pa.
Sanders	Prime Manufacturing Co., Milwaukee, Wis.
Fire extinguisher and bracket	Walter Kidde & Co., Belleville, N. J.
Fire extinguisher	Pyrene Manufacturing Co., Newark, N. J.

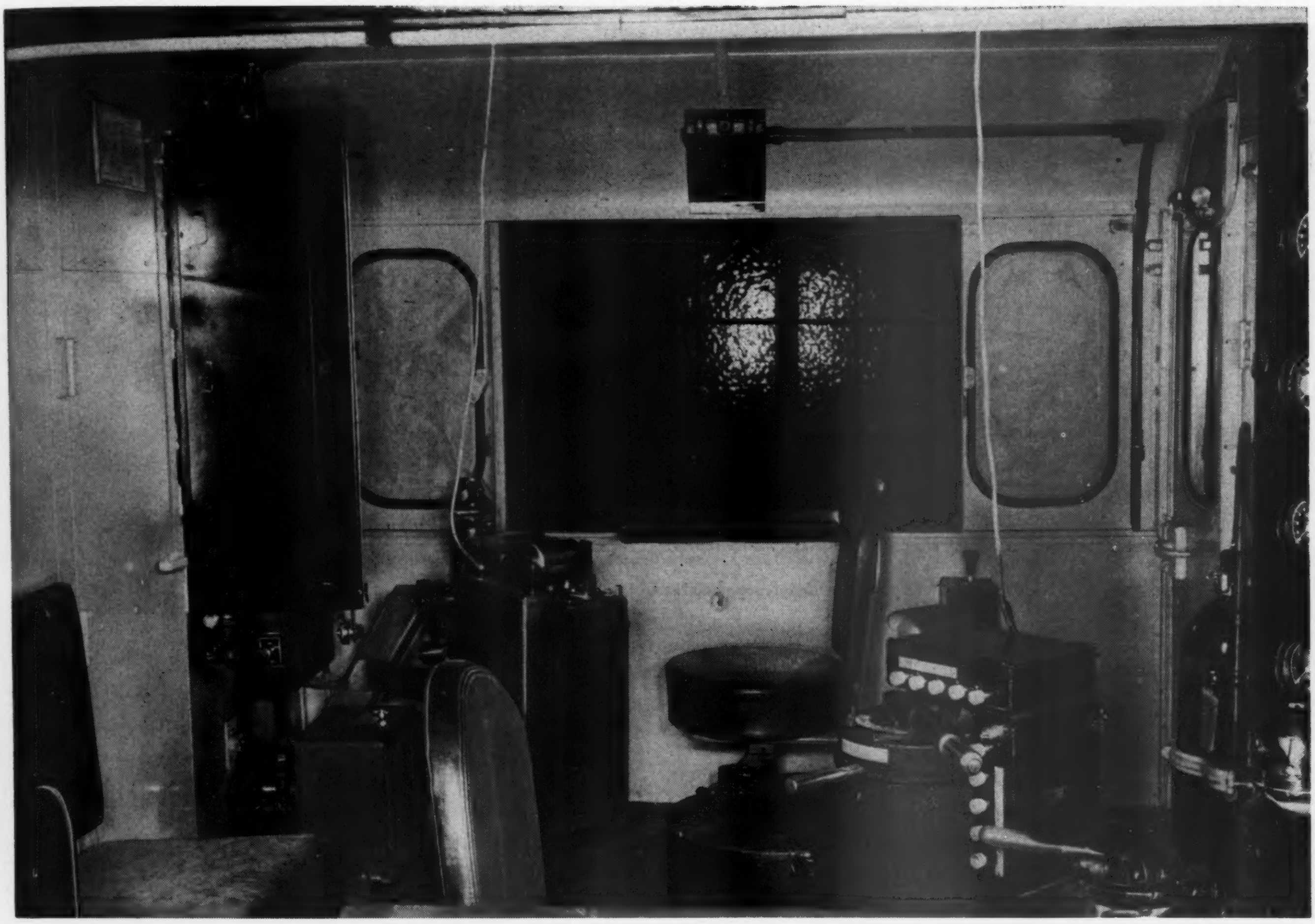


Operator's control station

With few exceptions, all locomotive components of the new Lima-Hamilton 2,500-hp. unit, such as the hood, operator's compartment, trucks, underframe, pipe and fittings, lighting system, and other miscellaneous parts, are similar in construction to components of the 800- and



Side elevation of Lima-H[...]0-hp

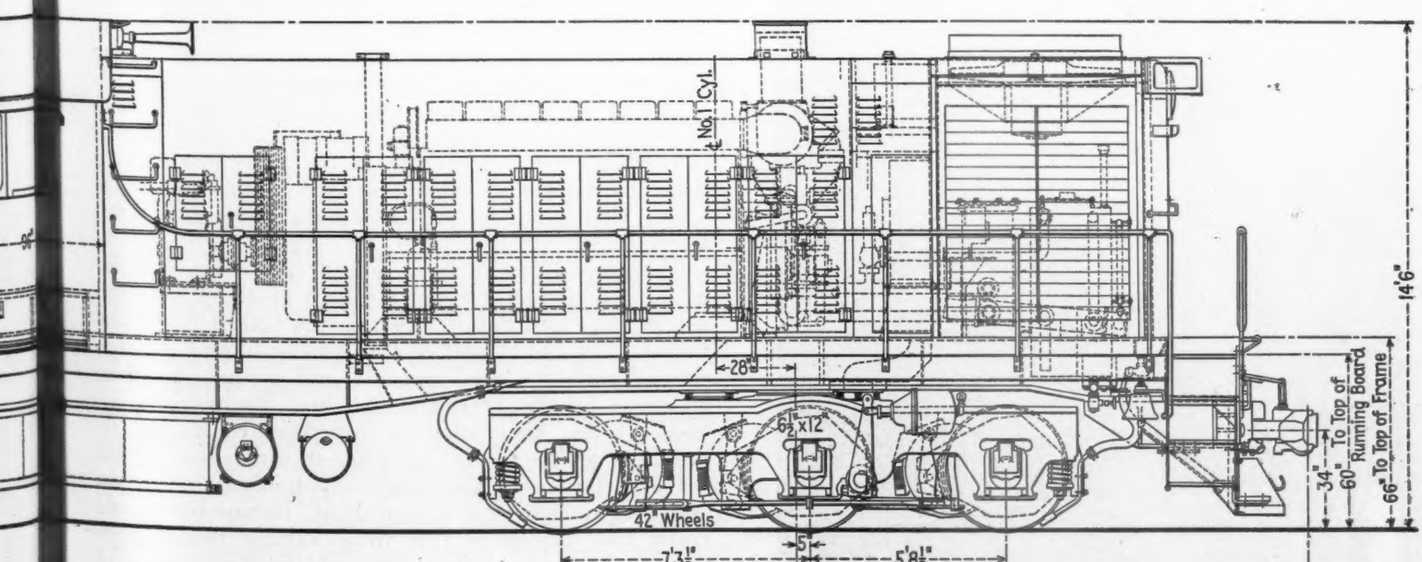


The cab opposite the control station

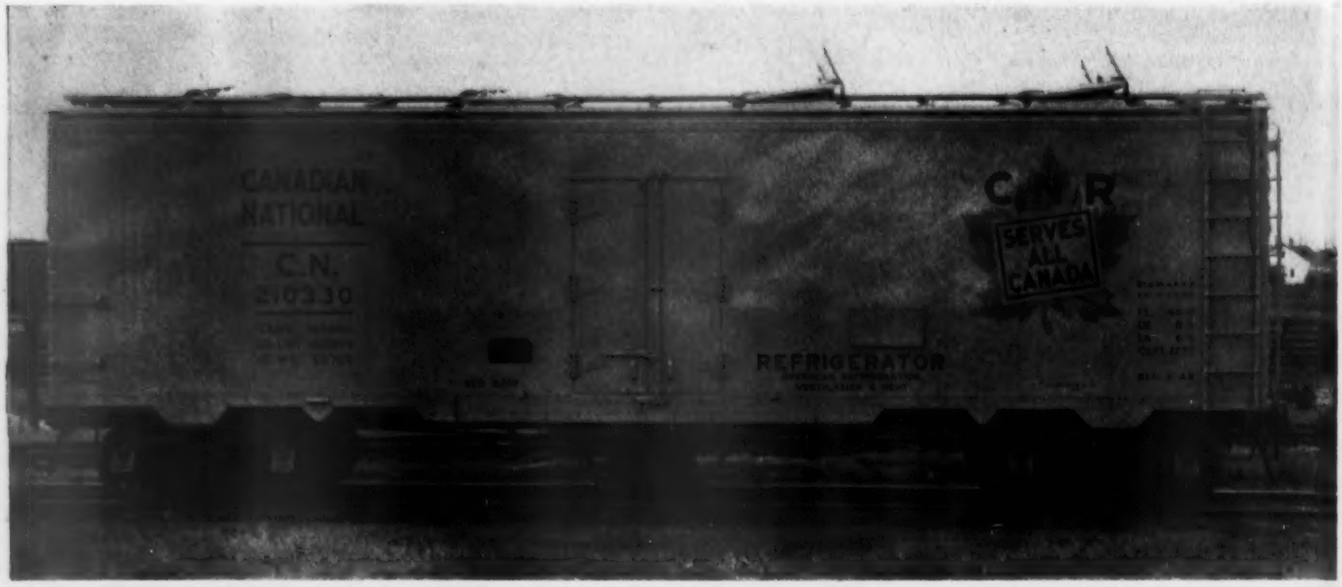
1,200-hp. Lima-Hamiltons. Trucks, for example, are of one-piece steel castings, equipped with plain-bearing journal boxes. The underframe is of welded construction.

Entrance to the operator's insulated compartment in the center of the locomotive is through a door on each side which gives access to the runboard. Sliding windows are provided on each side, while front and rear windows are fixed. All windows and doors have safety plate glass, mounted in special key-type rubber channels, offering easy removal and maximum safety against breakage.

(*Continued on page 378*)



a-Ham[illegible]0-hp. transfer locomotive



One of 300 all-steel refrigerator cars, with underslung heaters, turned out by the Transcona shops during 1948 and 1949

"Reefers" with Overhead Bunkers*

What these cars, now nearly 3,000 in number, are accomplishing in increasing car loads and reducing ice consumption — Underslung charcoal heaters being applied — Sliding doors on trial

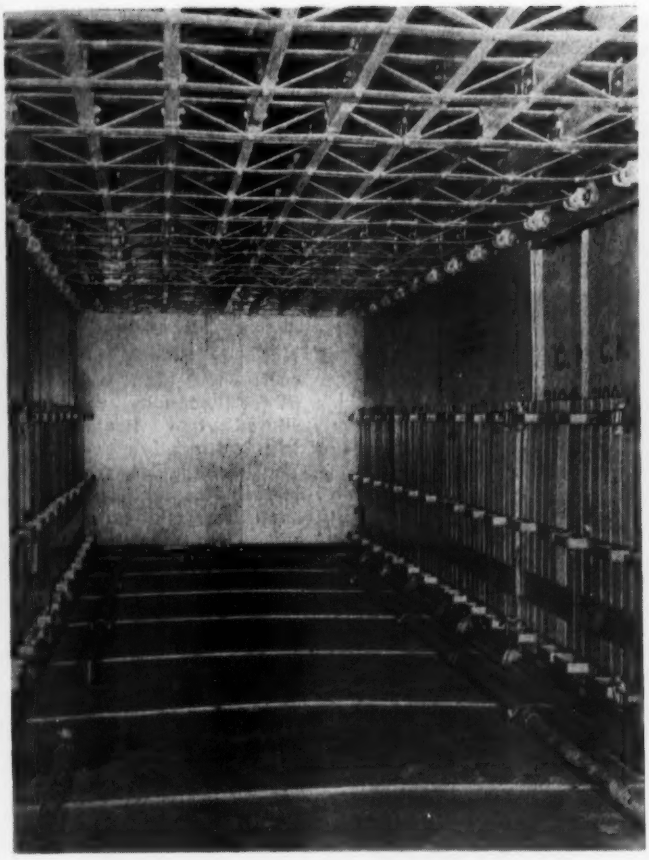
By A. N. Campbell†


The outside charcoal heater transmits the heat to the interior by means of liquid circulating through interior radiator pipes—A Canadian Pacific car

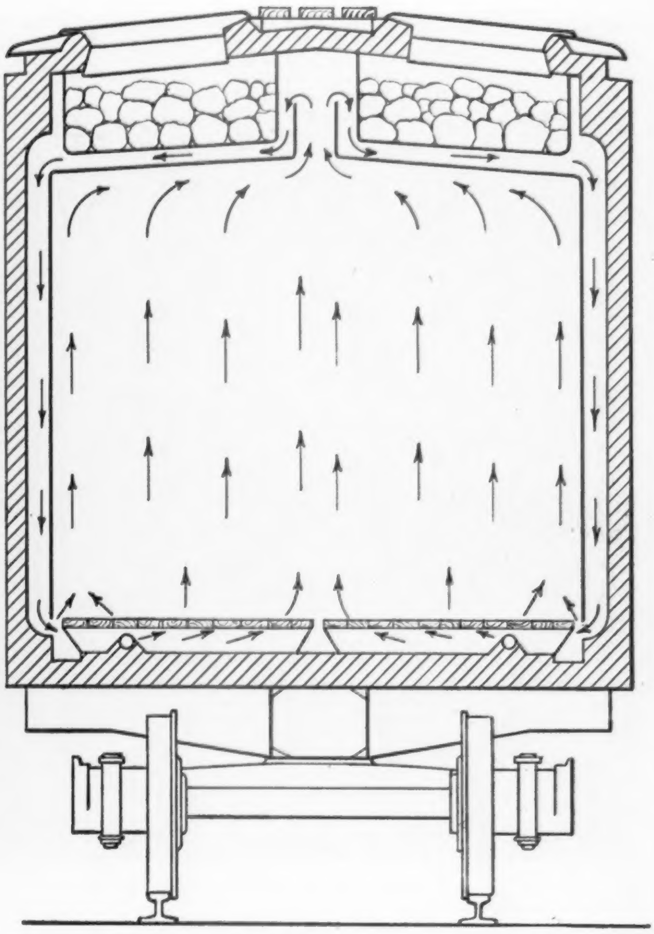
In Canada, all of the refrigerator cars in the country are owned and operated by the railroads. In the 1930's farsighted Canadian car designers took a different approach to the problem of the shortcomings of the end-bunker refrigerator car. They foresaw that the economy of the country, the growth of scores of industries and the well being of millions of Canadians would depend for years to come on the transportation of Canada's foodstuffs over long distances through great extremes of temperature. They choose to modernize their present ownership of the end-bunker refrigerators and to keep them up to date with latest designs of this car in the United States, but to build new cars along entirely different lines.

They found this to be a difficult task. The designer of the refrigerator car must adhere to all of the mandatory rules and requirements of the United States and Canada. No car of untried type can be offered in interchange until it's size, capacity, and design have been approved by the Transportation and Mechanical Divisions of the Association of American Railroads. He has little leaway as far as exterior dimensions of the car are concerned, and practically none as far as the design of running gear is concerned. In case this should create the impression that these various requirements tend to discourage originality and the development of

* From a paper presented before the Toronto Railway Club on April 24.
† Assistant vice-president, International Equipment Company, Ltd., Montreal Que.



Floor racks raised in the Canadian National overhead iced refrigerator car, showing welded floor and heater pipes



The air-circulation circuit in the overhead-bunker refrigerator car.

new ideas in design on the part of individual railroads, it must be understood that all of these regulations are adopted for the common good and upon the vote of the majority of the railroads which make up the A.A.R. membership.

In contemplating redesigning their refrigerator cars completely, Canadian railroad engineers had no alternative but to start out with A.A.R. standards. They used the latest types of trucks, draft gears and other running gear, all strictly in accordance with the requirements of the A.A.R. Upon these trucks they built a steel underframe and superstructure meeting all A.A.R. strength requirements actually following closely the A.A.R. standard design of steel-sheathed box car which has proved itself capable of withstanding fifteen years or more of the most rigorous railway service.

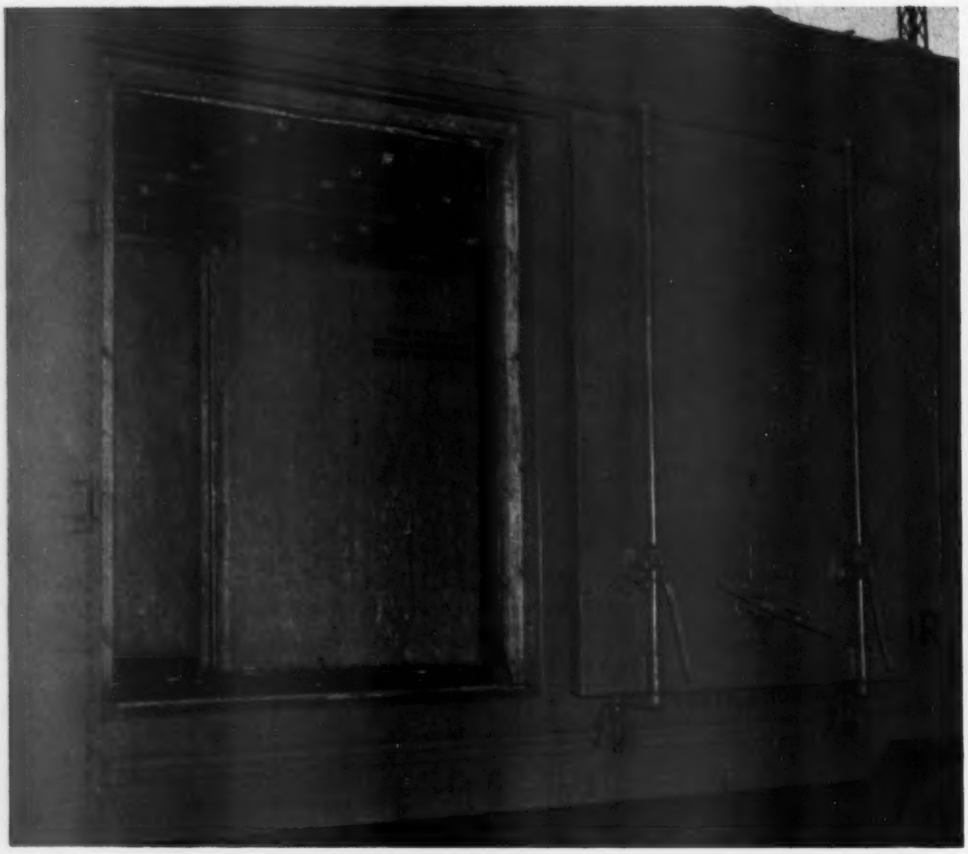
Inside the outer steel sheathing an additional steel shell is built, completely insulated from the outside frame by means of four to five inches of the best insulation obtainable. Very careful planning was necessary to avoid any metal-to-metal contact between the inside and outside metal shells. It is calculated that one bolt passing from the inside to the outside of a refrigerator car can cause a heat loss of from three to four B.t.u. per hour. In the old end bunker cars, heat loss in this manner was calculated at 27 B.t.u. per hour, or about 20 per cent of the total heat leak through the walls, floor and roof of a car. About 28 per cent of the area of the side walls of a wood-sheathed end-bunker car was not properly insulated due to framing members occupying space which should have contained efficient insulation. Wood has more than four times the conductivity of good insulation. Therefore, the difference in heat loss between the modern Canadian refrigerator car and the old end-bunker car is considerable, explaining, in part, record savings in ice established with the new design of car. Moisture in the insulation has much to do with insulating value, hence the outside steel shell is sealed with riveted or welded joints, while the inside steel shell has welded joints which are flooded with asphalt as an additional vapor barrier.

Overhead Bunkers

Instead of locating the ice at the ends of the car as in the end-bunker design, Canadian engineers benefited from the experiences of a sister member in the British Commonwealth of Nations and based their design on that of refrigerator cars constructed previously and operated by the South African Railways and Harbours Board.

Under the insulation in the roof of the car shallow ice tanks, eight in number, are mounted in such a way that they can be filled with ice from the roof of the car. These tanks retain a reservoir of cold brine in them even after all the ice load has melted. They hold about seven thousand pounds of ice and salt when filled and, with a 30 per cent to 70 per cent mixture, the temperature of the melting ice is 6 deg. below zero.

Below the ice tanks are plywood drain pans which collect any condensation which may form on the surface of the cold tanks. The drain pans nested closely together form the ceiling of the car. The side walls are composed of shallow flues covered with plywood inside lining. The floors are metal, welded at the joints so that no moisture can get down into the underframe or insulation. Floors



The sliding door now in use on some Canadian National refrigerator cars.—This car is of 50-tons capacity, ventilated and heated, with overhead icing—The sliding door was installed at the Transcona shops and the car was put in service in May, 1950

are specially sloped and formed to clear moisture from the cars. Floor racks allow free air circulation under the load transversely, longitudinally and vertically through openings in the racks.

Under the drain pans in the ceiling of the car there are specially designed meat racks so that dressed carcasses of meat can be carried as well as other perishables. The Canadian car is an all-purpose type designed to carry any perishable commodity ordinarily shipped by rail.

Underslung Heaters

New Canadian cars are equipped with an underslung charcoal heater carried under the car where it can be quickly examined and serviced from the ground. This type of heater was developed about fourteen years ago by the Canadian railways with the co-operation of the National Research Council. The device is much similar in principle to the portable charcoal heater, but is larger and more reliable. It has a firepot with an adjustable draft control, fed automatically from a magazine above holding 50 to 60 lb. of charcoal. Copper coils in the heater connect to heater coils under the floor racks through which anti-freeze heated in the firepot circulates throughout the car. Air, heated by the coils, rises through the load, evenly heating it by natural convection. Anti-freeze is used so that the liquid in the pipes will not freeze when the car is under refrigeration, or when it is traveling empty with no fire in the heater at Canadian winter temperatures.

With the underslung heater, the differences in temperature of lading at various locations is rarely more than a few degrees and there is no poisonous carbon monoxide gas liberated in the car to damage fresh meats or inconvenience men working with the cars. Tests are now being made in Canada with a thermostatically controlled heater. Canadian railroads are proceeding cautiously; they must be sure that a device is absolutely reliable under the most unfavorable conditions which may be encountered before adopting it.

A distance-reading thermometer, located in the outside sheathing of Canadian refrigerator cars, indicates at a glance what temperature exists inside the car at the top and bottom of the load. This device is so designed that it is completely unaffected by outside temperatures or by temperatures which exist between the dials on the outside of the car and the location where the temperature determination is desired.

When cars are not equipped with distance-reading thermometers, it is a custom to light the heaters when the outside temperature goes down to a specified level, regardless of the temperature of the air or the load inside the car. This is the only way in which protection for the load against freezing can be provided. Since the installation is not the same in all cars, heaters are sometimes lighted when they are not required and overheating damage results. When cars are equipped with thermometers which indicate temperatures of the load without opening the doors, arrangements can be made to light the heaters only when the load requires it. This is the sensible and safe way of transporting perishables in cold weather. Conversely, readings of the thermometer on the side of the car indicate when reicing of the load is necessary in summer. Often the temperature inside a car is such that icing at some regularly scheduled icing station can be avoided, resulting in considerable savings both in time and expense to the railroad and the shipper. Without the thermometers, however, it is the custom to reice cars without regard for the immediate requirements of the lading when the outside temperature at the time indicates that certain refrigeration protection is necessary. By the

use of the distance-reading thermometers, a great deal of guesswork is eliminated.

Since the original Canadian designs of overhead refrigerator cars were adopted, refinements have been added from year to year as experience and tests proved their worth. The drain traps on one type of Canadian overhead car are located midway between the center and the ends of the car to keep the drainage away from the trucks and running gear, avoiding, in part, at least, some of the corrosion to these parts which results from their exposure to brine drippings in the ordinary type of car. Sliding doors, first applied for test several years ago, have now been improved and are now being installed on additional cars for further tests. Still other refinements are now being studied. Canadian railroads in the past eleven years have placed in service nearly three thousand units of the Canadian overhead type refrigerator car. They have invested over thirty-five million dollars in them. Now let us see what they obtained for their initiative, ingenuity and investment.

Performance

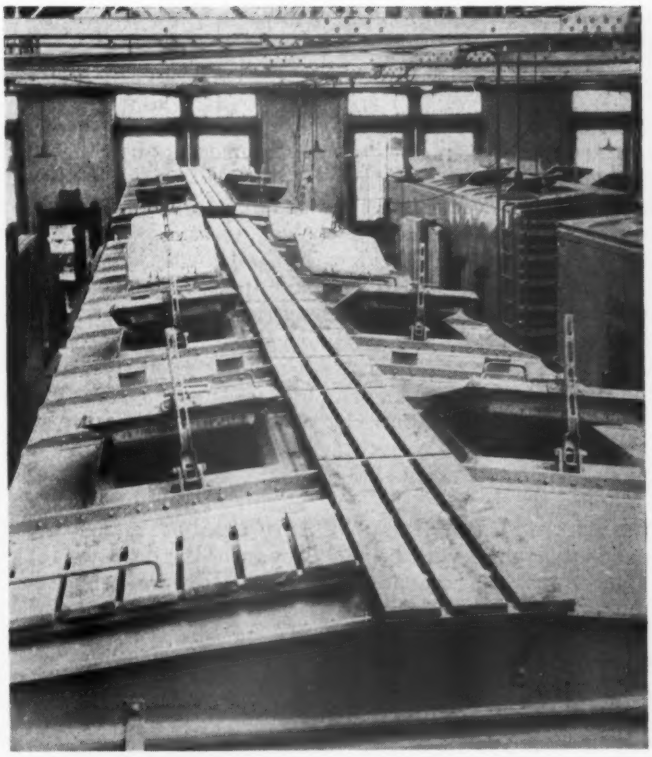
With the end-bunker cars, about 7 ft. of longitudinal floor space (over 300 cu. ft. of the interior) is taken up by the ice bunkers and, due to the necessity for allowing space at the sides, at the center and over the load for air circulation, only a part load of perishables can be handled. In the overhead iced car every cubic inch of loading space can be utilized. In the last few years a great deal of emphasis has been placed on building lighter cars so that more payload can be carried per car, resulting in a reduction of the number of cars used to carry the same quantity of goods.

Prior to the war the average load carried in an end-bunker car was about 35,000 lb. The overhead iced car is often loaded to over 90,000 lb. and the load limit is over 100,000 lb. In addition, it requires considerably less ice, which, of course, is dead weight on which the railway gains no revenue and for which the shipper pays.

In the end-bunker car perishables cannot be loaded higher than the top of the bunker bulkhead, otherwise the flow of air is stopped and the load could not be cooled properly. Seven hundred fifty to 800 boxes of apples are carried in an end-bunker car, while the overhead car carries 1,152 boxes. The end bunker carries 550 crates of oranges, while the overhead car carries 840 crates. As against 660 egg crates in the end bunker, the overhead iced car carries 900 crates.

In addition to freight charges, the railway patron—the shipper of a perishable commodity—must bear the cost of icing and heating. Refrigeration is usually charged for according to the number of tons of ice and pounds of salt used, since a large precooled or frozen load costs no more to refrigerate than a small load. The overhead iced car requires less ice than the end bunker car and it is common for transcontinental loads in overhead iced, thermometer-equipped cars originating at Prince Rupert to require only one to three re-icings en route, against seven re-icings at each regular icing station, 24 hr. apart, for an end-bunker car with a smaller load. Ice economies for the railway shipper may exceed $100 per trip.

Along with these economies both to the shipper and the railway, the overhead iced car does an all-around better job whether the commodity requires heating, ventilation or refrigeration. The air around the tanks in the ceiling of the car is cooled and falls down through the flues behind the lining in the walls of the car. It is



Eight hatches serve the overhead ice tanks

liberated under the floor racks and, as it picks up heat from the load, it goes straight up to the ceiling ice tanks where it is cooled again. The air needs to travel only about 25 ft. regardless of the length of the car as against air travel of about 47 ft. in an end-bunker car.

In spite of this record, the Canadian railways are not resting on their laurels; they are watching every development. They would like to reduce the cost of building and maintaining their cars with their 500 odd different parts. They would like to be able to hold temperatures still lower at reasonable cost. They would like to be able to reduce their investment of millions of dollars in ice each year.

Canadian railroads actually use about 200,000 tons of ice each year for refrigerator cars. They buy about 300,000 tons (about 10,000 carloads) at a cost of over two million dollars, as one third shrinks away before it is used. Ice is harder to obtain every year. Canada, the land of ice and snow, has found it necessary to import thousands of dollars worth of ice.

Ice Limitations

Ice alone will not produce temperatures lower than 32 deg. F. in the coldest part of the car, as this is the lowest temperature at which ice melts. By adding salt, the melting point is lowered. Ten pounds of salt added to 100 lb. of ice will produce a temperature of 21 deg. above zero. Thirty pounds of salt with 100 lb. of ice will produce a temperature of 6 deg. below zero. The temperature in the car is, of course, somewhat higher than that of the refrigerant and the addition of a quantity of salt to ice in an end bunker car, particularly, is not a reliable indication of temperature which will be obtained, as the salt rattles down through the ice to the bottom of the bunker. Residue from impurities in the ice, which runs as high as 10 per cent, forms a stone-like deposit in the drain pans and tanks of refrigerator cars. The salt

further provides a problem in that it quickly corrodes car parts and causes considerable damage to tracks and bridges as it escapes in solution from the drains of the car.

As much as 2,600 lb. of brine may drain from one refrigerator car in 24 hours. Brine drippings cause thousands of dollars worth of damage to tracks, bridges, and car parts every year. The report of the Federal Coordinator of Transport published in 1935 estimated damage to tracks and bridges in the United States from this cause may amount to $420,000 per year. One Canadian railroad has tested out hundreds of types of paint in the hope of finding an inexpensive miracle product which will resist brine corrosion without greatly increasing the cost of the cars.

Canadian railroads have experimented with the use of dry ice which costs many times that of water ice, but is about twice as efficient. Solid carbon dioxide melts at 109 deg. F. below zero and is, therefore, difficult to transport and store. Use of this type of refrigerant avoids difficulties with brine and reduces the dead weight of ice transported about the country. However, the gas liberated from dry ice has a bad effect on the flavor of certain perishables and a discoloring effect on certain meats.

Canadian railroads have experimented further and find that they can obtain temperatures as low as 15 deg. F. below zero in their overhead cars by the use of salts other than sodium chloride (table salt), commonly used. The cost is considerably higher, however, and delays for re-icing increase correspondingly.

Plastics are often mentioned as promising materials for freight-car construction, particularly where their resistance to brine corrosion is an advantage. One Canadian railroad is testing plastic flues in the interior of an overhead iced refrigerator car, and in the United States one company is now offering a lightweight hatch cover made from plastic.

Mechanical Refrigeration

As in Canada, United States refrigerator car owners are experimenting with methods of refrigerating cars without using ice and salt. An ammonia absorption system was installed in a few cars several years ago. Ammonia carried under the car expended in coils inside, then was absorbed by a tank of water. Special supplies and equipment for recovering the ammonia were required and further installations were not considered practical.

About 20 years ago 80 cars were placed in service equipped with a refrigeration system which depended upon the adsorption of the refrigerant by silica gel reactivated by a propane gas flame. Some of these cars were tried out in Canada. They were demonstrated as incapable of providing uniform temperatures much lower than 20 deg. F. and, therefore, were considered to be no better than ordinary refrigerator cars.

British Columbia packers are at the present time pleading for uniform zero refrigeration which even the overhead iced car cannot provide. The Canadian Department of Fisheries are interested and, as a result, a Canadian railroad car has been fitted up with a mechanical refrigeration system powered by two gasoline motors. This device, as far as railway operation is concerned, is still in the test stage. Its future is obscure, due to the fact that the A.A.R. rules of interchange prohibit the free movement of cars equipped with machines using fuel such as gasoline, and it is doubtful if railroad insurance companies will accept the risk of operating freight cars so equipped.

Freedom of movement of railway cars equipped with machines using Diesel fuel oil are not affected by the A.A.R. rules, but, in the past, Diesel engines were not built small enough for the purpose. Recently a suitable Diesel engine has been developed in the United States and two cars have been fitted up with Diesel powered mechanical refrigeration. These cars have been used successfully to transport frozen orange juice concentrate from Florida to New York and Boston. In tests, the cars have been loaded at 8 deg. below zero in 75-deg. weather, proceeded to destination and maintained the same temperature at unloading. The United States car line operating these two test cars has now ordered ten more to be put into service this year.

It is obvious that, in the future, there will be new developments in the handling of perishable railway traffic so vital to the life and development of the nation and its resources. However, thousands of cars are involved and every new development which is adopted must show a profit—in reduced building costs; in reduced maintenance of cars, tracks, bridges or other facilities; in traffic held; in traffic gained, or in better service to railway patrons. When a device or design is proved to possess one or more of these advantages, I am confident that Canadian railways will be one of the first to adopt it.

Pennsylvania 2,500 Hp. Switcher

(*Continued from page 373*)

Differences between this and other Lima-Hamilton locomotives are found in the air-brake equipment and in the trucks. The air-brake equipment is a 24 RL dual-station, automatic and self-lapping straight-air brake. The trucks have six wheels. The electrical equipment, which is Westinghouse throughout, includes six Type 370DL traction motors, series type, axle hung, forced ventilated, and equipped with single-reduction gearing which drives the locomotive. Other electrical equipment includes two main generators, Type 499-B, two exciters, two fan generators, and two traction-motor-blower motors.

The eight-cylinder, 9-in. by 12-in. Lima-Hamilton Diesel engines in the locomotive are pressure-charged to develop 1,250 hp. each. The pressure-charging is accomplished by an Elliott pressure-charger, and is accompanied by intercooling the pressure-charged air between the charger and the engine intake. This inter-cooling of intake air produces lower temperatures throughout the cycle. The Diesel engine, and all its parts, are also interchangeable with the engines in the 1,200-hp. locomotives.

Controls are electro-pneumatic, with two stations for the operator. The controls are used with a Woodward-type governor and governor operator, and a Woodward-type load control using a face-plate type rheostat. Traction motors are connected in two groups of three in series across the generator. Two steps of field shunting are provided with automatic switching. There is push button control of lighting and other auxiliary apparatus. Compressed air for electro-pneumatic apparatus is 70 lb. per sq. in. while wheel-slip relays operate a light, warning the engineman when the slipping of a pair of wheels occurs. The tractive-force curve indicates speed-tractive effort characteristics.

Diesel-Electric Locomotive Units In Railway Service

Class I railroads' Diesel-electric locomotive inventory increased by 2,755 units—more than 33 per cent—in 1949

As of December 31, 1949, there were 11,996 Diesel-electric locomotive units in railway service, of which 10,973 units were owned by Class I railroads in the United States, excluding switching and terminal companies.

The Diesel-electric locomotive inventory of Class I railroads was increased by 2,755 units — more than 33 per cent — from 8,218 units, as of December 31, 1948, to 10,973 units as of the same date in 1949. This increase in a period of twelve months includes 19 units of 2,250 hp.; 214 units of 2,000 hp.; 1,505 units of 1,500 hp.; 8 units of 1,200 hp.; and 1,009 units of 1,00 or less hp.

Switching and terminal companies and Class II and III railroads owned approximately 1,023 Diesel-electric locomotive units of 851,868 horsepower as of December 31, 1949.

The Diesel-electric locomotive units in service on Class I railroads, switching and terminal companies excluded, as of December 31, 1949, were as follows:

	Number of Units	Horsepower Each Unit	Total Horsepower
	36	3,000	108,000
	19	2,250	42,750
	1,230	2,000	2,460,000
	36	1,800	64,800
	3,855	1,500	5,782,500
	1,170	1,350	1,579,500
	21	1,200	25,200
	4,606	1,000 or less	3,947,100
Total	10,973		14,009,850

The following tabulation presents, for the first time, the number of Diesel-electric locomotive units in service on each Class I railroad, arranged according to various horsepower classifications.

DIESEL-ELECTRIC LOCOMOTIVE UNITS IN SERVICE ON CLASS I RAILWAYS

Excluding Switching & Terminal Companies—As of December 31, 1949

Railroad	Number of Units in Various Horsepower Classes* 3000	2250	2000	1800	1500	1350	1200	1000 or less	Total Units	Total Horsepower†
Akron, Canton & Youngstown	....	....	4	....	1	....	....	2	7	11,160
Ann Arbor	....	....	....	....	....	....	....	3	3	1,680
Atlanta & St. Andrews Bay	....	....	....	....	1	....	....	11	12	12,500
Atlanta & West Point—W. of Ala.	....	....	....	....	5	....	....	6	11	13,500
Atchison, Topeka & Santa Fe	....	....	58	13	236	320	....	237	864	1,149,550
Atlantic Coast Line	....	....	59	....	24	72	....	34	189	284,800
Baltimore & Ohio	....	....	32	12	102	24	....	171	341	431,960
Bangor & Aroostook	....	....	2	....	20	....	....	4	26	38,000
Bessemer & Lake Erie	....	....	....	....	2	....	....	2	4	4,530
Boston & Maine	....	....	21	....	22	70	....	57	170	210,100
Central of Georgia	....	....	10	....	14	....	....	25	49	63,380
Central of N. J.—Cent. of Pa.	....	....	6	....	44	....	....	31	81	101,460
Central Vermont	....	....	....	....	....	....	....	3	3	3,000
Chesapeake & Ohio, incl. P.M.	....	....	12	....	19	....	....	114	145	163,300
Chicago & Eastern Illinois	....	....	3	....	36	....	....	18	57	74,060
C. & N. W.—C. St. P. M. & O.	....	....	45	....	114	8	....	153	320	393,550
Chicago, Burlington & Quincy	....	3	67	4	110	74	2	136	396	537,370
Chicago Great Western	....	....	9	....	68	....	....	42	119	157,680
Chicago, Indianapolis & Louisville	....	....	....	....	47	....	....	10	57	79,700
Chicago, Milwaukee, St. P. & Pac.	....	....	35	....	62	52	....	118	267	332,400
Chicago, Rock Island & Pacific	....	....	31	....	77	48	6	127	289	341,360
Clinchfield	....	....	....	....	10	....	....	...	10	15,000
Colorado & Southern	....	....	2	....	....	....	....	4	6	8,000
Colorado & Wyoming	....	....	....	....	....	....	....	3	3	3,000
Columbus & Greenville	....	....	....	....	5	....	....	2	7	8,700
Delaware & Hudson	....	....	....	....	26	....	....	32	58	71,000
Delaware, Lackawanna & Western	....	....	....	....	55	20	....	54	129	149,040
Denver & Rio Grande Western	....	....	6	....	55	48	....	37	146	190,760
Detroit & Mackinac	....	....	....	....	6	....	....	1	7	9,660
Detroit, Toledo & Ironton	....	....	....	....	....	....	....	9	9	8,200

* Number of Units Based on A. A. R. Statistics. † Horsepower Compiled by the Simmons-Boardman Publishing Corporation.

DIESEL-ELECTRIC LOCOMOTIVE UNITS IN SERVICE ON CLASS I RAILWAYS—CONTINUED

Railroad	Number of Units in Various Horsepower Classes								Total	
	3000	2250	2000	1800	1500	1350	1200	1000 or less	Units	Horsepower
Duluth, So. Shore & Atlantic	....	....	3	....	3	....	....	7	13	17,500
Elgin, Joliet & Eastern	....	....	31	....	10	....	....	107	148	167,900
Erie	....	....	12	....	119	24	....	103	258	324,340
Florida East Coast	....	....	26	....	18	....	....	...	44	79,000
Ft. Worth & Denver City	....	....	2	....	....	....	....	5	7	8,600
Georgia	....	....	....	....	3	....	....	8	11	12,500
Grand Trunk Western	....	....	....	....	22	....	....	36	58	67,390
Great Northern	....	....	13	....	114	96	....	89	312	412,240
Green Bay & Western	....	....	....	....	5	....	....	4	9	10,360
Gulf Coast Lines	....	....	2	....	36	....	....	15	53	70,250
Gulf, Mobile & Ohio, incl. Alton	....	....	13	1	134	....	....	83	231	309,080
Illinois Central	....	....	24	....	....	....	....	63	87	91,580
Illinois Terminal	....	....	....	....	....	....	....	9	9	9,000
International-Great Northern	....	....	4	....	32	....	....	15	51	69,400
Kansas City Southern	....	....	13	....	29	....	....	25	67	94,160
Lake Superior & Ishpeming	....	....	....	....	3	....	....	...	3	4,500
Lehigh & New England	....	....	....	....	26	....	....	7	33	45,660
Lehigh Valley	....	....	14	....	43	8	....	61	126	156,200
Long Island	....	....	....	....	....	....	....	41	41	32,160
Louisiana & Arkansas	....	....	3	....	22	....	....	12	37	51,000
Louisville & Nashville	....	....	28	....	5	....	....	70	103	116,360
Maine Central	....	....	7	....	18	....	....	17	42	51,280
Midland Valley-K. O. & G.-O. C.-A.-A.	....	....	....	....	6	....	....	1	7	10,000
Minneapolis & St. Louis	....	....	....	....	12	9	....	36	57	63,150
Minneapolis, St. P. & S. Ste. M.	....	....	....	....	56	....	....	18	74	100,180
Missouri-Illinois	....	....	....	....	1	....	....	1	2	2,500
Missouri-Kansas-Texas	....	....	6	....	59	....	....	17	89	117,100
Missouri Pacific	....	....	22	....	128	24	....	60	234	315,790
Nashville, Chatt. & St. Louis	....	....	....	....	30	....	....	24	54	67,580
New York Central System	....	....	89	....	193	10	....	341	633	714,460
New York, Chicago & St. Louis	....	....	11	....	....	....	....	57	68	78,380
New York, New Haven & Hartford	....	....	90	....	57	....	....	151	298	370,080
New York, Ontario & Western	....	....	....	....	7	18	....	26	51	57,700
New York, Susquehanna & Western	....	....	....	....	....	....	....	22	22	20,380
Norfolk Southern	....	....	....	....	10	....	....	8	18	20,780
Northern Pacific	....	....	....	....	68	44	8	56	176	224,000
Northwestern Pacific	....	....	....	....	....	....	....	2	2	760
Pennsylvania	22	....	187	....	180	....	....	439	828	1,049,650
Pittsburgh & Lake Erie	....	....	4	....	....	....	....	37	41	45,000
Pittsburgh & West Virginia	....	....	4	....	....	....	....	1	5	9,000
Reading	....	....	....	....	25	20	....	116	161	167,100
Richmond, Fredericksburg & Potomac	....	10	....	....	16	....	....	22	48	68,500
St. Louis-San Francisco	....	....	6	....	113	....	....	84	203	260,510
St. Louis Southwestern	....	....	3	....	....	20	....	32	55	65,000
Sacramento Northern	....	....	....	....	....	....	....	6	6	2,280
Seaboard Air Line	14	....	55	....	57	43	....	38	207	332,470
Southern Pacific (Pacific)	....	....	36	....	297	....	....	150	483	654,280
Southern System	....	....	35	....	258	70	....	146	509	686,620
Spokane International	....	....	....	....	....	....	....	8	8	8,000
Spokane, Portland & Seattle	....	....	1	....	23	....	....	25	49	60,820
Staten Island Rapid Transit	....	....	....	....	....	....	....	7	7	6,400
Tennessee Central	....	....	....	....	....	....	....	11	11	10,320
Texas & New Orleans	....	....	12	....	36	....	....	66	114	140,660
Texas & Pacific	....	....	10	....	37	....	....	22	69	97,500
Texas Mexican	....	....	....	....	2	....	....	14	16	12,560
Toledo, Peoria & Western	....	....	....	....	9	....	....	...	9	13,500
Union (Pittsburgh)	....	....	....	....	33	....	....	74	107	113,740
Union Pacific	....	....	54	6	281	....	5	167	513	712,680
Wabash	....	6	8	....	39	....	....	50	103	129,120
Western Maryland	....	....	....	....	10	....	....	20	30	30,060
Western Pacific	....	....	....	....	9	48	....	24	81	98,380
Wheeling & Lake Erie	....	....	....	....	....	....	....	4	4	4,000
Total	36	19	1,230	36	3,855	1,170	21	4,606	10,973	14,009,850

Note: Since the number of Diesel-electric locomotive units in the above tabulation were based on A. A. R. statistics, only those units, received by the railroads from the builders, that were reported to the A. A. R. as installed in 1949, were included.

Starting Requirements For Locomotive Engines*

By F. H. Brehob†

Electric starting, using power from a storage battery, is now practically the universal method used for cranking the Diesel engines on locomotives. In most cases the main generator is arranged to serve as a starting motor, although some small engines used in locomotive work are equipped with automotive type starters.

While the battery serves for other purposes as well as for starting, its size is fixed principally by the engine cranking requirements and, in some cases, to a certain extent by characteristics of the starting motor.

As the size of the engine increases, the battery capacity required also increases. The locomotive builder should have a reasonably accurate knowledge of the engine starting requirements, so that provision can be made in the locomotive design for the correct size of battery and so that the starting motor can be built to have the correct starting characteristics. A battery larger than necessary is a handicap in cost, weight, and space. On the higher powered locomotives this is an important consideration, because it is difficult to keep the locomotive within the weight limitations dictated by desirable axle loading. For that reason all the apparatus entering into the construction of the locomotive must be made as light and as compact as possible in order to arrive at an acceptable economical overall design. A battery smaller than necessary may be the cause of failure to start under adverse conditions. Such a situation should be avoided.

Sometimes the engine builder is unable to state the starting requirements accurately. This may be partly due to the lack of a convenient means of measuring these requirements or it may be due to his experience having been with engines arranged for air starting. The locomotive builder has taken the initiative and has made tests to attempt to determine the starting requirements when the engine is cranked electrically.

Basic Requirements

The locomotive designer needs to know three fundamental things regarding engine starting: (1) maximum torque during first revolution, (2) torque at firing speed, and (3) firing speed.

While the initial "crack-off" torque may be relatively high, it has been found that the greatest torque occurs on the first full or complete compression stroke. It is conceivable that, on an engine with many cylinders (perhaps 16 or more), the "crack-off" torque may be the highest because as the number of cylinders increases, one cylinder on compression would have proportionately less effect. Maximum torque during first revolution, hereafter called MT, has also been called breakaway torque, but it is believed this term is misleading in that it is frequently understood to mean crack-off torque. MT may also be defined as the highest torque required during the starting cycle.

The term "torque at firing speed", hereafter called FT, is the torque demanded by the engine at the speed at which the engine will start to run under its own power. This torque is largely used to overcome friction, but also includes the torque required to drive the engine auxiliaries, such as fans, supercharger, fuel, water and lubricating oil pumps. There is another element that increases the torque at firing speed, namely, the effect of compression and expansion. While a large part of the energy put in at compression is regained on expansion, the recovery is not 100 per cent. Therefore, additional torque has to be supplied to make up these losses.

The firing speed should be specified as the minimum speed at which, in a reasonable time of cranking under extreme conditions, some cylinders will fire and the engine continue to run under its own power. Under normal locomotive service conditions, electric starting equipment has generally caused the engine to start in less than five seconds. For abnormal conditions, such as low temperature, the firing speed should be high enough to start the engine within approximately 10 to 20 seconds after cranking power is first applied. If greater starting time is required there would appear to be reason to raise the starting speed and thereby reduce the drain on the battery. In other words, it would be better to supply equipment with sufficient capacity and proper characteristics to insure starting in not over 20 seconds. A time appreciably greater than that would require a relatively larger battery to stand the drain. This additional capacity might better be used to attain a firing speed that will start the engine promptly. Battery size also depends on how many attempts to start are desired without recharging or waiting for recovery. In general, two or three attempts in succession should be sufficient.

Data and Starting Tests

Table I gives principal information on a number of engines on which the starting requirements have been determined electrically. The following may be of interest:

1.—All engines are of the in-line type except Nos. 2 and 9 which are of the Vee type.

2.—In some cases the test results shown for a given engine were not all made on one engine but do apply to a duplicate engine.

3.—If certain tests had been repeated on a different engine of the same design or even on the same engine, the result might vary some from that shown. It has been found that it is difficult to duplicate the results from trial to trial.

4.—On engines Nos. 4 and 5, the test results under MT are for crackoff only and do not include additional torque required to overcome compression.

5.—Engine No. 9 was provided with compression release and also used a priming lubricating oil pump which reduced the initial starting torque (MT).

The cranking current can be measured accurately with

* A paper presented before the American Society of Mechanical Engineers, Oil & Gas Power Division at Baltimore, Md. June 14, 1950
† Locomotive Engineering Division, General Electric Company

TABLE I—DIESEL ENGINE DATA AND STARTING TESTS

Engine No.	Hp.	R.p.m.	Cycle	Bore in.	Stroke in.	No. of Cyl.	Super-charged	Mat. Torque Lb.Ft. (*MT*)	Temp. deg. F.	Torque at Firing Speed Lb.Ft.(*FT*)	Temp. deg. F.	Firing Speed Min. R.p.m.(*FS*)	Temp deg. F.
1	300	1200	4	6¾	8¾	6	Mech.	1040	...	315	...	214	...
2	190	1000	4	5¾	8	8	No	880	75	280	75	151	75
								940	160	250	160	136	160
3	300	550	4	10	12	6	No	2300	25	520	25	40	Warm
								4000	Hot				
4	600	750	4	10	12	8	No	2550	78	800	78	30	70
5	660	750	4	10½	12	8	No	1800	71	900	87	50	87
6	660	700	4	12½	13	6	No	5500	120	600	120		
								7400	180	600	180		
								5600	53	1500	56	47	53
7	800	550	4	14¾	16	6	No	9700	...	2100	60		
8	660	1000	4	9	10½	6	Turbo	2900	32	1800	32	90	32
9	2000	550	2	14	16	10	No	2500	...	4700	112	50	112

an oscillograph. Knowing the current, the designer of the starting motor can accurately determine the torque delivered. The oscillograph can also be set up to measure accurately the speed and speed changes due to acceleration or deceleration. Knowing the inertia characteristics of the motor, proper allowances can be made to determine the actual torque delivered to the engine.

Some of the characteristics in Table I were measured by simple indicating instruments. It is desirable to use a stable exciter, on which the voltage can be varied and accurately controlled by field control, in place of the battery. It is also desirable to use a constant heavy field on the starting motor. By trial and error a voltage can be set on the exciter, then the starting switch closed. With a few trials, a condition can be obtained where a steady state current is flowing, which can be measured on an ammeter, that is just about right to give the proper current from which to determine the MT.

To obtain the torque at firing speed the engine can be prevented from firing by cutting off fuel injection. (This should be done only with engine builder's consent because of possible injury to fuel injection apparatus with fuel shut-off). While this is being done it is desirable to motor the engine through quite a range in speed as it has been found that the motoring torque increases somewhat with increasing speed. By gradually lowering the exciter voltage and reducing the speed, a point will finally be reached (generally below the lowest firing speed for extreme conditions) where the ammeter becomes unstable. This indicates the presence of pulsations due to alternate compression and expansion in combination with the lowered kinetic energy of the rotating masses, which cause a non-uniform angular velocity of considerable magnitude. For example, it was found on a certain six-cylinder engine that instability occurred at about 45 r.p.m. In this case the minimum firing speed recommended was 75 r.p.m., even though the engine started at 45 r.p.m. when warm.

Some interesting results have been observed on the starting tests of some of the engines listed in Table I. For example, Lamborn's and Davidson's tests reported in the A.I.E.E. proceedings in 1941 show a higher MT on an engine when hot than when cool. The same condition was observed on a three-power locomotive which had a large propulsion battery of about 500 v. and a six-cylinder, 10 inch by 12 inch engine. A resistor was used to limit the starting current. This resistor was selected to permit a flow of current which, based on previous tests, it was believed would start the engine. The engine started satisfactorily at normal temperatures and frequently when warm. It was found, however, that when the engine was quite warm immediately after shut-down it would not start. The engine turned only a fraction of a revolution and stopped on a compression stroke. It is believed this was due to three factors: (1) The pistons were hot and had a snugger fit than normal; (2) The pistons and cylinder walls were well lubricated since the engine had just been run, and this lubricant formed such a good seal on the pistons and rings and possibly the valves that there was practically no blow-by; (3) The air trapped in the cylinder for the first compression stroke may have been heated to an abnormally high temperature by the hot cylinder and piston. This would then mean the cylinder which caused stalling was approaching a higher compression pressure than normal.

On the two-cycle engine it was considered advisable to use compression release to reduce the MT. Since this engine had no regular valves the compression release valves applied were relatively small. It was found when turning the engine over at approximately firing speed that the torque required was greater when the compression release valves were open than when they were closed. This is undoubtedly due to the fact that, with compression release open, considerable work was done on the air in heating, compressing and forcing it through the relative small passage. This energy was wasted with practically no return to the engine on the expansion stroke.

Empirical Formulas

Accurate starting information is sometimes difficult to obtain from the engine builder. In view of this fact, it seems desirable to attempt to evolve approximate empirical formulas, based on the test results reported in Table I which can be used as a guide in the absence of better information.

In order for such formulas to be of maximum value, they should be expressed in factors which are readily known about the engine and, therefore, easily available.

It is believed that engine horsepower and speed do not have a vital bearing on starting requirements. For example, an engine that is supercharged may rate considerably greater horsepower but it is still fundamentally the same engine when the supercharger is omitted. The starting requirements should be about the same in either case, except that the supercharged engine may require a higher firing speed if it is built with greater volume in the combustion space when the piston is at top dead center, since this means a lower compression pressure and temperature. Valve timing could also affect the starting characteristics.

Compression ratio affects starting somewhat, but since this factor is not always immediately available, an attempt should be made to ignore it in a simple formula. In general all Diesel engines have a high compression ratio within a narrow range and it is believed that the variation is insufficient to warrant added complications in the formulas.

Arrangement of cylinders has some influence, especially on maximum torque. This is true if the firing order spacing is uniform on one engine and non-uniform on an

another. A Vee-type engine, perhaps, requires somewhat less torque at firing speed than an in-line engine because of less bearing area.

Since the torque at firing speed increases as the temperature decreases, it should be fixed by the lowest temperature which will normally be encountered in service.

The cooling system on a Diesel-electric locomotive is generally of such large capacity that the use of anti-freeze solutions is too expensive. Furthermore, there are generally facilities for storing the locomotive in a building that can be kept above freezing temperature when not in use. For certain engines which are known to be "hard starters" at low temperatures, heaters are used to keep the engine warm. In emergencies it may be possible to heat the air inlet on the engine with a torch to facilitate starting or to use some other starting aid.

Therefore, it seems unnecessary to figure on a starting temperature lower than 40 deg. F. for locomotive service, especially in view of the fact that at lower temperature the size of the battery required would increase rapidly.

The MT includes two fundamental elements: (1) that required to overcome compression and (2) that required to overcome friction and to drive the engine auxiliaries. Torque for acceleration to firing speed must also be supplied, however, allowance need not be made for this because of the regain in torque on expansion.

The torque required to overcome compression has been found to be greatest at the first complete compression stroke although one or more additional cylinders may be undergoing a partial compression simultaneously. The torque to overcome compression is a function of cylinder area and moment arm. This function may, therefore, be expressed as K_1D^2L *where* K_1 is a constant, D is cylinder diameter, and L is length of stroke. The constant may be made large enough to evaluate partial compression of one or more cylinders occurring simultaneously with the complete compression of one cylinder.

The torque required to overcome friction may also be measured in terms of cylinder dimensions because the surface swept by the pistons is such a large part of the total friction surface and because the bearing size increases with cylinder size. While the surface swept by the pistons is measured by the diameter and length of the piston, or perhaps more accurately by the diameter of the piston and the width of the piston rings, nevertheless the piston is longer and rings wider on larger pistons more or less in proportion to diameter. Therefore K_2D^2LN may be chosen to evaluate the friction where K_2 is a constant and N the number of cylinders or pistons. Inasmuch as the size of auxiliaries increases with engine size, which is a function of D^2LN, it is necessary to use the proper value of K_2 to represent all these component elements.

The complete formula for maximum torque MT during the first revolution now becomes:—

$$MT = K_1D^2L + K_2D^2LN \ldots\ldots (1)$$

$$\text{Simplifying} \quad = D^2L(K_1 + K_2N) \ldots\ldots (2)$$

To a large extent, the same conditions as regards friction and engine auxiliaries prevail when cranking at firing speed as for breakaway. Since, in torque at firing speed, the cranking effort required for compression is largely regained, the expression K_1D^2L in the MT formula may be omitted. It is true that there is not 100 per cent recovery of energy from compression to expansion but by the time the engine has attained firing speed the bearings may be better lubricated to compensate for the compression losses. A further gain is undoubtedly realized because of localized heating of the oil film at the bearings which reduces the viscosity and, therefore, the required torque. Consequently the last expression of formula (1) appears reasonable for the torque firing speed, which may be written:—

$$\text{Torque at firing speed } (FT) = K_2D^2LN \ldots (3)$$

Based on the tests of the four-cycle engines listed in Table I, a factor of 2.5 for K_1 and .18 for K_2, where D and L are in inches and the torque in pound-feet, appears to give reasonably accurate results.

For two-cycle engines of the same number of cylinders or pistons, there will be twice the compression strokes per revolution. Therefore, it is suggested to raise the factor K_1 to 3.2. This increase also recognizes that this factor is intended to include an allowance for driving the scavenging blower on a two-cycle engine. In addition, it appears reasonable to increase factor K_2 to .2.

It is believed that the necessary firing speed is influenced by cylinder diameter, because the smaller the cylinder the greater is the ratio of perimeter to area. Therefore, there is a greater opportunity for heat loss on compression in a small cylinder. To make up for this increased heat loss the firing speed on a smaller bore engine has to be greater. It is believed that the firing speed is not a function of engine speed at full load.

Based on tests of engines with different cylinder sizes, an approximate formula for firing speed is given below. This applies only to four-cycle engines in the range of cylinder sizes used for locomotive engines:—

$$\text{Firing speed R.p.m.} = 25 + \frac{550}{D}$$

where D is the diameter of the cylinder in inches.

For a given cylinder size it is believed the minimum firing speed for a two-cycle engine is about the same as for a four-cycle engine.

Summarizing above formulas:—

For four-cycle engines of conventional design:—

$$\text{MT (in lb.-ft.)} - D^2L\,(2.5 + .18N) \ldots\ldots (5)$$

$$\text{FT (in lb.-ft.)} = .18\,D^2LN \ldots\ldots (6)$$

$$\text{FS (in rpm)} = 25 + \frac{555}{D} \ldots\ldots (4)$$

where D = diameter of cylinder inches
L = length of stroke inches
N = number of cylinders or pistons

For two-cycle engines of conventional design using the same units as above:—

$$MT = D^2L\,(3.2 - .2N) \ldots\ldots (7)$$

$$FT = .2\,D^2LN \ldots\ldots (8)$$

$$FS = 25 + \frac{550}{D} \ldots\ldots (4)$$

The conditions under which the above formulas are believed to be reasonably applicable may be summarized as follows:—

1—Engine temperature at 40 deg. F. Above 40 deg. F the requirements will be less. Below 40 deg. F the MT increases, the FT increases faster and an increasingly higher firing speed is required as the temperature is lowered.

2—The MT is believed to be sufficiently high for a hot engine, where the torque may be greatest a few minutes after the engine has been shut down.

3—Engines with simple combustion chambers.

4—Engines with precombustion chambers require a higher firing speed, up to perhaps 150 per cent of the speed derived from the formula, or must be warmed when starting, or require both.

5—Uniform or nearly uniform spacing of firing order from cylinder to cylinder.

6—Up to eight cylinders an in-line type engine: more than eight cylinders a Vee-type engine. It is believed that a Vee-type engine requires less starting power due to the shorter crankshaft with fewer, and possibly smaller, bearings.

7—Starting time is less than 5 seconds under normal conditions and not more than 20 seconds under adverse conditions.

8—Engine lubricated with S.A.E. 30 oil having the average viscosity index which is commonly used. Heavier oils will increase the torque at low temperatures to some extent at breakaway and will increase the required torque at firing speed considerably. The viscosity characteristics of the oil will, of course, have a decided effect.

9—For an opposed piston type engine it is suggested that the MT be figured from the formula on the basis of two engines in multiple i.e., use the values in the formula where N is the number of cylinders then multiply the result by 2. It will be noted that the formula for torque at firing speed will give the same result figured either way i.e., if considered as two engines, using N as the number of cylinders will give the same result as using N as the number of pistons on one engine.

10—For supercharged or non-supercharged engines, except that for a supercharged engine the firing speed derived from the formula should, perhaps, be increased by 15 to 25 per cent, if the volume above the piston is greater than for a non-supercharged engine.

11—No compression release. For engines with compression release consider the breakaway torque at about 140 per cent of the torque at firing speed to compensate for higher crack-off friction and for acceleration to firing speed.

12—Fuel oil of normal ignition characteristics—about 50 Cetane. A low Cetane number fuel requires a higher firing speed.

Application of Formulas

It will be noted from Table II that in most cases the formulas give somewhat higher torque values than the test values, also in most cases the formula speeds at firing are higher than the minimum.

TABLE II—APPLICATION OF FORMULAS

Engine No.	Maximum Torque (MT) Test	Maximum Torque (MT) $D^2L(2.5 + .18N)$	Firing Torque (FT) Test	Firing Torque (FT) $.18D^2LN$	Firing Speed (FS) Test	Firing Speed (FS) $25 + \frac{550}{D}$
1	1040	1430	315	430	214	106
2	940	1040	280	380	151	121
3	4000	4300	520	1300	40	80
4	2550	4700	800	1730	30	80
5	1800	5200	900	1900	50	77
6	7400	7200	1500	2180	47	69
7	9700	12400	2100	3740		62
8	2900	3040	1800	930	90	86
		$D^2L(3.2 + .2N)$		$.2D^2LN$		
9	2500	16300	4700	6250	50	64

Engines No. 1 and No. 2 have special or precombustion chambers. The result is that the firing speeds derived from the formula are lower than required, showing the need for setting the firing speed higher on engines of this kind. The author was not involved in the test on engine No. 1, but it is believed the firing speed was that actually obtained with the starting equipment used and that it is greater than the minimum required.

Since the tests for engine No. 8 are at 32 deg. F, there is an indication that the torque and speed must be increased for starting below 40 deg. F.

The reduction in maximum torque by having forced lubrication at standstill and compression release is indicated by the vast difference between test value and formula value on engine No. 9.

Conclusion

Inasmuch as there are so many factors in the design and operation of an engine that influence the starting requirements, the empirical formulas presented in this paper can obviously not fit all engines accurately. It is believed however that, where the requirements of an engine under consideration are not known accurately, these formulas may serve as the starting point and guide as to which factors may be applied to allow for particular characteristics of the engine under consideration and for the service conditions in which it is to be used.

* * *

Courtesy General Electric Company

ELECTRICAL SECTION

Performance of Diesel Locomotive Generators

Fundamental requirements of electric power generators used to supply the needs of Diesel-electric locomotives

PART I

*By C. A. Atwell**

PERFORMANCE of a Diesel-electric locomotive generator depends on performance of the Diesel engine. The usual form of engine performance curve is shown in Fig. 1 for two common engine sizes. If the engine manufacturer's curve shows the results of a maximum-power factor test, the horsepower values must be discounted for locomotive operation. The amount of this discount results from experience with the engine in actual service. A second subtraction must be made for the horsepower used by locomotive auxiliaries. The remainder after these two subtractions is called the "net horsepower to generator for traction."

Curves of Fig. 1 show engine horsepower after these subtractions have been made. The full-speed point on such a curve represents rated net horsepower for traction. This is where the required generator performance starts—it receives a specified rated net power input from the engine at full speed.

Volt-Ampere Curve for Rated Net Horsepower Input to Generator

A direct-current generator delivers its power output in the form of volts and amperes. The curve UA in Fig. 2 shows the shape of the volt-ampere curve a generator takes when receiving full rated net power from the engine.

A volt-ampere curve of this form can be extended indefinitely at both ends, providing the efficiency is known for the ampere points chosen. Any generator, however, must have practical operating limits. Too high a prolonged amperage will overheat the armature and commutating field coils due to I_2R losses or will cause commutation limits to be exceeded. The ampere limit for continuous operation is shown as point C_1 in Fig. 2. Point A is the ampere limit for short-time operation. At the other end of the curve, too high voltage may cause flashing between brushholders, insulation breakdown, or overheating of the main field coils due to high field amperes required. The voltage limit for continuous operation is point C_2. Operation at high voltage points such as U and V can be utilized for shorter periods. The point U is called the "unloading point". At ampere values less than U, the engine will not be loaded fully by the generator. Very little actual operation occurs at less amperes than point U, so that the engine is fully loaded for practically all operating ampere values.

Field Excitation Required

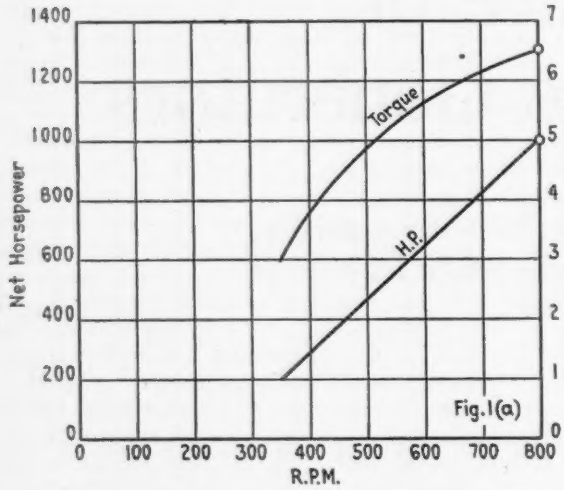
Before field excitation controls can be specified, it is first necessary to find out the values of field excitation the generator must have to produce the proper combinations of volts and amperes. The required field-ampere curve is determined from a shop test of the generator in which it is supplied with full rated net input and loaded at the various volt-ampere combinations shown in Fig. 2. These field ampere values are shown plotted in Fig. 2 on the same sheet as the load-voltage curve. When a control means is provided for supplying these field amperes, the volts required at each load ampere value will be obtained and the engine will be exactly loaded to its full rated net horsepower over the operating range of load amperes.

Several different control schemes for automatic adjustment of field amperes have the same objective —that of supplying the right generator field excitation so that the generator will be able to use all of the available net horsepower for traction, yet

* Transportation Design Engineer, Westinghouse Electric Corporation, East Pittsburgh, Pa.

not to overload the engine and cause it to lose speed and power.

The decision of whether or not to use a separate exciter for the generator is dependent on the horsepower rating of the generator and the type of locomotive service. With the higher voltages of large generators, self-excited field coils would have a large number of turns of conductor that must be insulated for full generator voltage. With an exciter,



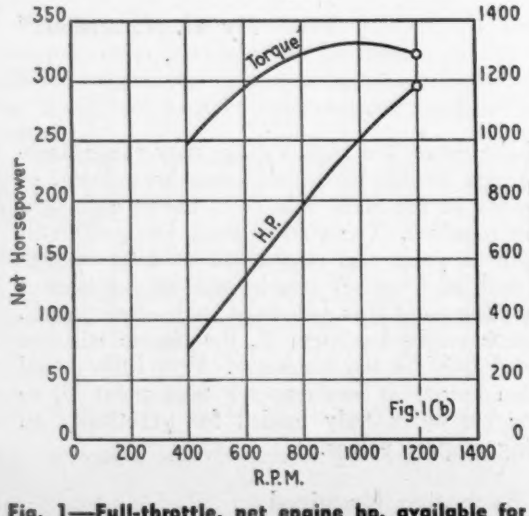


Fig. 1—Full-throttle, net engine hp. available for traction is shown after deductions have been made for atmospheric conditions and engine power used for auxiliaries —The upper curve is for an engine with a net rating of 1,000-hp. at 800 r.p.m. and the lower curve shows an engine with a net rating of 295-hp. at 1,200 r.p.m.

the generator field voltage can be kept low (150 volts or less) even for the largest Diesel-electric generators in use today, and the field coils will have relatively few turns. Furthermore, a separate exciter means that only the small amperes and voltages of the exciter field need be controlled.

The exciter is another piece of apparatus, however, and its use is not economically as justifiable with lower powered generators. In light switching service, simplicity of equipment is desirable and extreme accuracy of engine loading is not essential as it is in larger locomotives. The practical result of experience indicates that generators with inputs over 300 to 350 hp. should have separate exciters.

Differential Exciter With Auto-Load Control System

Figure 3 shows main generator and exciter connections for a modern control system using an exciter combined with Auto-Load control. The generator has but one separately excited field. The exciter has three fields: self-excited; differential series using main generator amperes; and a separately-excited, externally controlled field using only a few amperes.

The Auto-Load device of Fig. 3 controls the exciter separate field automatically to obtain exact engine loading under the variable conditions of high or low engine power. It provides for changes in resistances of field windings with temperature, and slight variations in generator efficiency due to temperature changes of its windings.

It is desirable for the generator to utilize all the net horsepower for traction that the engine will furnish. Since engine power changes rapidly with speed, control of the exciter separate field is based on speed. With the Auto-Load arrangement of Fig. 3, a very slight decrease in engine speed introduces more resistance into the exciter field. This reduces the exciter voltage and, in turn, the main generator voltage and relieves the engine of the slight overloading that caused the speed to decrease. This automatic correction is made at any main generator ampere value between the "unloading point" and the "maximum load point". A simple and practical method of varying the exciter field is to use the same oil pressure that operates the engine speed governor to operate a small control cylinder and piston. A slight reduction in engine speed due to overloading allows oil to be admitted to this cylinder and reduces the spring pressure on a Carbonstat regulator. This causes a decrease in the exciter separate field amperes and allows the engine to return immediately to its full speed. The result is complete use of all

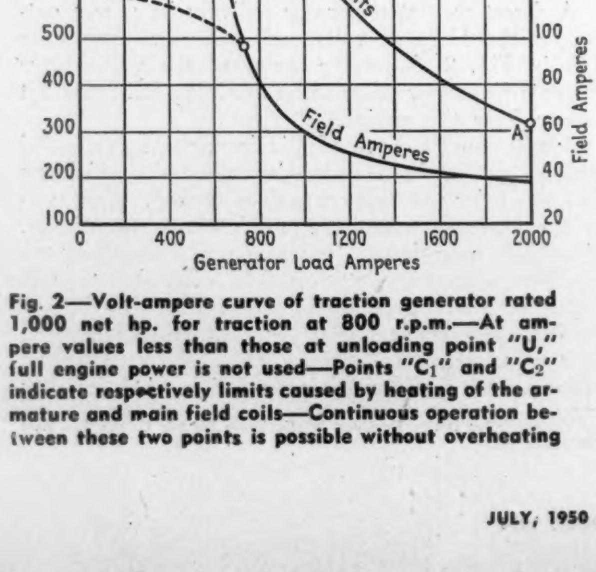


Fig. 2—Volt-ampere curve of traction generator rated 1,000 net hp. for traction at 800 r.p.m.—At ampere values less than those at unloading point "U," full engine power is not used—Points "C_1" and "C_2" indicate respectively limits caused by heating of the armature and main field coils—Continuous operation between these two points is possible without overheating

of the "net horsepower for traction" that the engine is supplying at full speed within very close limits of variation.

Generator Performance at Reduced Speeds

The foregoing discussion has been on the basis of the generator receiving "rated net horsepower for traction" at full speed. Considerable locomotive operation is done with engine governor settings to give less than full speed. At lower speeds, correspondingly lower net power for traction is available. Figure 4 shows a family of generator volt-ampere curves from full speed to engine idling speed. The dashed curves show the net engine output for typical speed setting translated into terms of generator output volts and amperes. The dotted curves represent the maximum capability of the generator in the same terms. Where the dotted curves are above the dashed curves, the generator will attempt to produce more power than the engine is delivering, thus overloading the engine and reducing its speed. The Auto-Load control will operate to reduce excitation as the engine begins to slow down, reducing the load until the engine is producing its full power at that speed. In this illustration, the Auto-Load will be operating down to slightly less than 700 r.p.m. Should the engine produce less horsepower than expected at some lower speed, 600 r.p.m., for example, the volt-ampere input curve at that speed might be below the generator curve at the same speed. In such case, the Auto-Load control would operate to prevent engine over-loading in the same manner as at full speed.

Another feature of the generator characteristic illustrated by the top curve in Fig. 4 is the automatic limiting of the maximum generator voltage. No matter how low the ampere load is, the generator voltage is limited. This makes unnecessary any special voltage-limiting control devices.

Maximum generator amperes are also automatically limited by the slipping of the locomotive wheels except in very special cases where maximum generator and motor amperes will not afford enough tractive force to cause the wheels to slip. In such special applications, ampere overload prevention devices are provided.

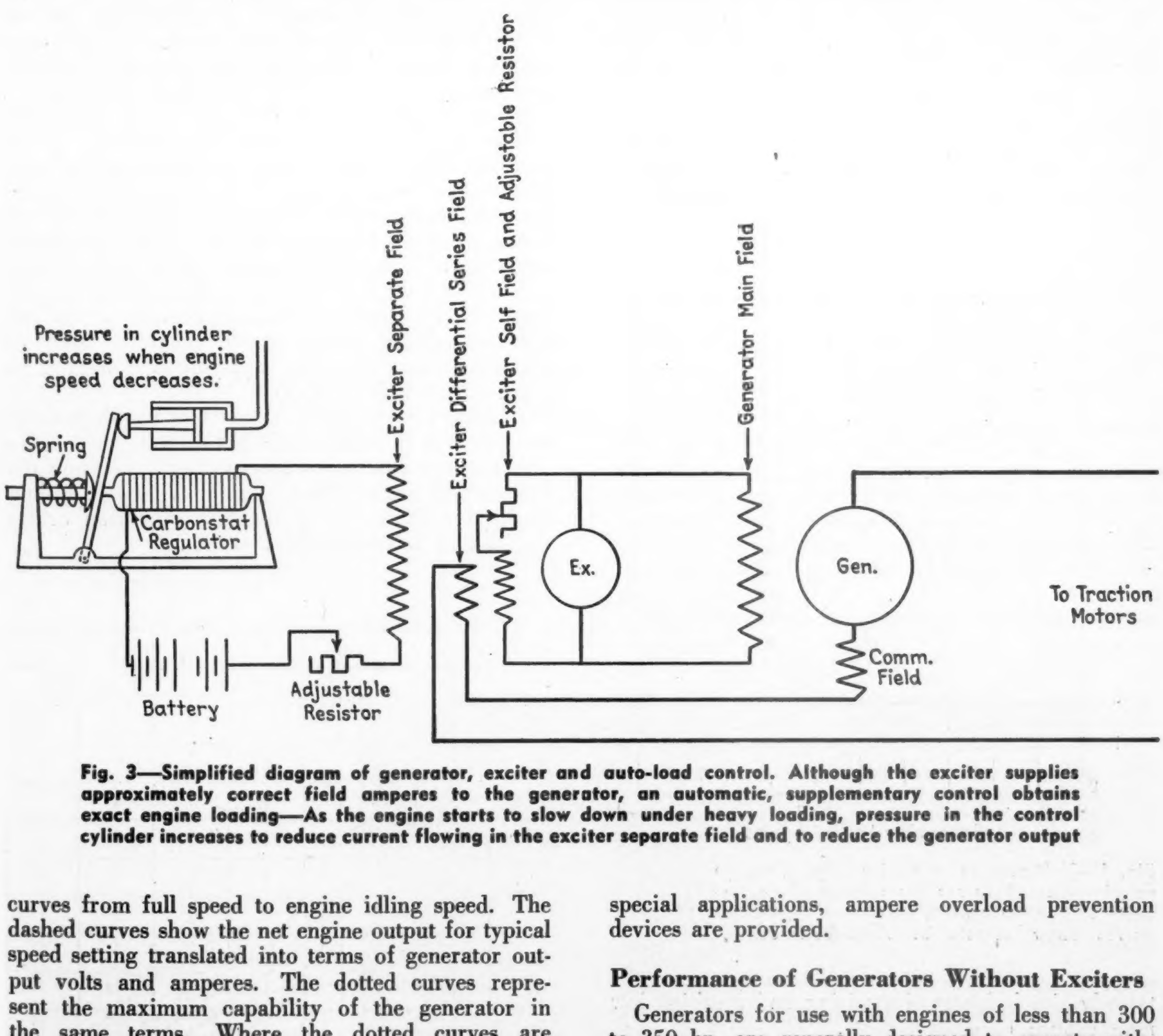


Fig. 3—Simplified diagram of generator, exciter and auto-load control. Although the exciter supplies approximately correct field amperes to the generator, an automatic, supplementary control obtains exact engine loading—As the engine starts to slow down under heavy loading, pressure in the control cylinder increases to reduce current flowing in the exciter separate field and to reduce the generator output

Performance of Generators Without Exciters

Generators for use with engines of less than 300 to 350 hp. are generally designed to operate without exciters. This means that some sacrifice is made in the accuracy of engine loading at the higher speeds. This is not a general disadvantage as the smaller switching locomotives are operated at full speed and horsepower only a small per cent of the time. A small amount of separate field excitation from a battery is provided in addition to the self-excited field to overcome the slow voltage build-up of a purely self-excited generator. The separate excitation can be removed by a relay after the self field is built up. Usually the generator characteristics are improved with the separate excitation present all the time.

Figure 5 shows performance curves of this type

of generator. Following the same scheme used in Fig. 4, the dashed lines show net engine output translated into terms of generator output volts and amperes at typical operating speeds. The dotted lines show the generator capability in the same terms at corresponding speeds. With this type of generator, a pull down from full engine speed occurs at certain load ampere values. The generator voltage drops much faster than its speed, however, so that a balanced condition is soon reached. The speed curve at the top shows the balanced performance of the generator when connected to an engine that supplied the net horsepower values indicated. The solid volt-ampere line results at this balanced speed. This illustration shows a maximum speed pull down from 1,200 to 1,050 r.p.m. between 800 to 900 load amperes. At either more or less amperes, the speed pull down is less. At speeds less than 1,050 r.p.m., the generator does not pull the engine down at any ampere load. This generator performance is obtained without the functioning of any external control devices, thus providing extremely simple locomotive wiring and resulting low maintenance of control parts.

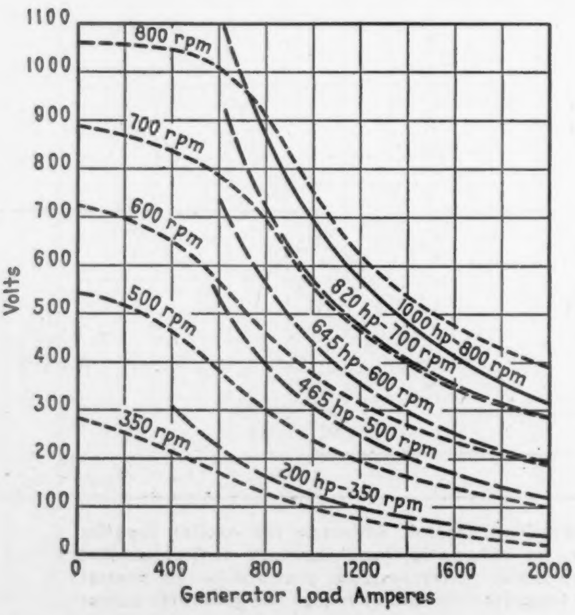


Fig. 4—Volt-ampere curves for reduced engine speeds—Dotted curves are natural characteristics of generator while corresponding dashed curves show effects of Auto-load control

Ratings and Ventilation

Temperature limits allowed for this type of generator are those given in A.I.E.E. Standards No. 11 for Class B insulation. These are 120 deg. C. rise by resistance for armature winding; 130 deg. C. rise by resistance for field coils; and 90 deg. C. rise by thermometer for the commutator. Class A insulation using combustible materials such as cotton, silk and paper are no longer used for modern Diesel-electric generators. The use of insulation with such non-combustible materials as mica, asbestos, glass fibre, and high temperature varnish, is one of the factors that has allowed modern Diesel-electric generators to be built within the sizes and weights that are now available.

A series of short time overload ratings ranging from one hour to five-minute periods is valuable data for application to a given service. A short-time rating is defined as the ampere load that can be carried for a stated length of time without exceeding safe temperature limits. In order to be definite, the temperature rise at the beginning of the overload also must be stated.

There are certain external conditions which will cause a generator to exceed its allowable temperature rises. Among these are high inlet air temperature, reduced amount of ventilating air, or reduced density of ventilating air due to operation at high altitudes. The first two of these conditions are largely in the hands of the locomotive builder. The temperature of the inlet air to the generator should be kept down to as near outside air as possible. The mounting construction should be such that there is no possibility of the warm air exhausted by the generator fan being recirculated to the air inlets. Improper restriction of either air outlets or inlets will produce a similar effect. Low density air will not remove as much heat as air at sea-level density. These conditions as well as the factory determined rating of the generator must be taken into account when applying a generator to a given locomotive service.

Because of the varied locomotive conditions and of operation in service, it is advisable to set locomotive tonnage ratings so that neither generators nor motors will exceed their continuous ampere ratings except for short period during acceleration or for negotiating relatively short grades.

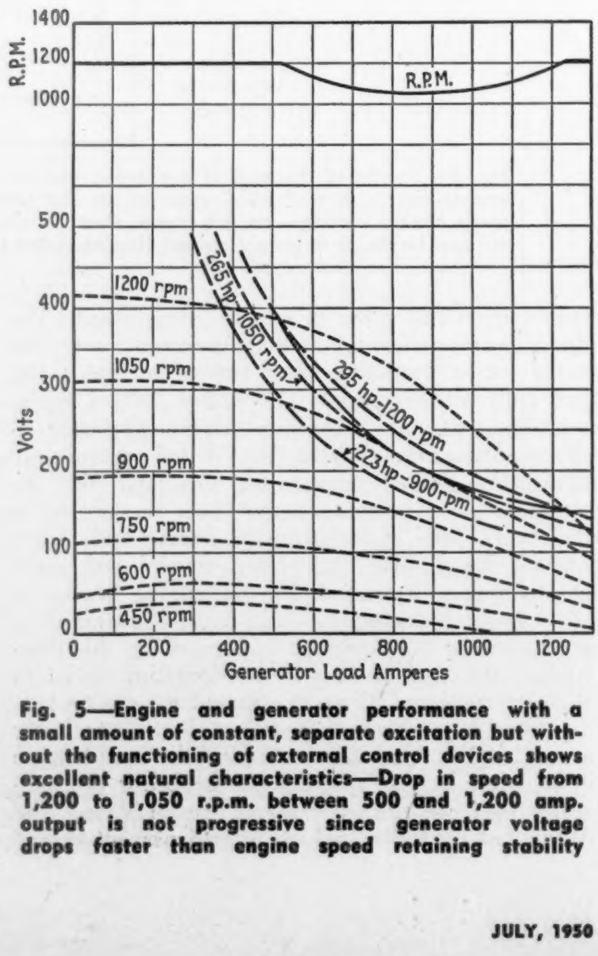


Fig. 5—Engine and generator performance with a small amount of constant, separate excitation but without the functioning of external control devices shows excellent natural characteristics—Drop in speed from 1,200 to 1,050 r.p.m. between 500 and 1,200 amp. output is not progressive since generator voltage drops faster than engine speed retaining stability

Taking the Mystery Out of Armature Winding

By preparing a drawing and dividing the work into several steps, mechanics may be easily taught how to wind armatures

*By C. F. Steinbrink**

EVERY railroad electric shop which anticipates overhauling Diesel-electric traction motors is faced with the shortage of skilled labor, and especially a shortage of armature winders. The miles of service that can be expected from the present day traction motor armature is approximately 750,000, and this means that an armature will require rewinding every fourth shopping. In other words, every fourth motor out of your shop will have a new winding and at twelve motor overhauls a week, this means three armatures to be wound per week.

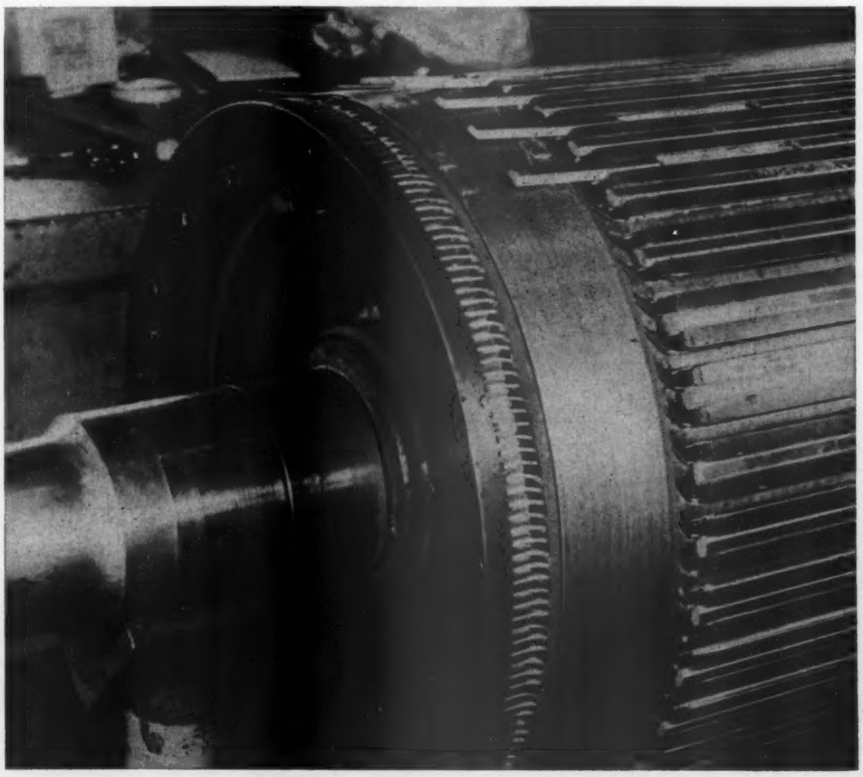
If you are one who is contemplating the operation of such a shop, you will be faced with the problem of training mechanics to do this winding, and it will have to be done with unskilled labor. Experienced winders are not available in sufficient quantities to supply the demand.

Your first step in training the men to do this work will require that you prepare a drawing (Fig. 1) showing the insulation, its shape, its size and its position on the armature core, and also a detail of each step required in placing the insulation. This is very important as it gives you complete control of every step required in winding an armature. Then as weak points or defects turn up and you make improvements, the drawing is revised and every one of your men is working to the same end.

The second step will be to divide the work and train the required number of men that will be needed for the number of operations you will have. For example, you may decide on six operations or divisions of the work. One man may clean, test and repair commutators, a second man will apply core insulation and equalizer coils and the insulation on top of the coils. The third man will apply lower armature bars and insulation on top of these lower bars. The fourth man will apply top armature coils and band insulation. The fifth man will apply steel wedges and temporary bands. The sixth man will solder commutators and silver solder the pinion end, and the armature will then go back to the fifth man who will apply permanent bands.

The more armatures you have for rewinding, the

* General Electrical Foreman, Chicago, Rock Island and Pacific.



Armature being wound with winding jig in place

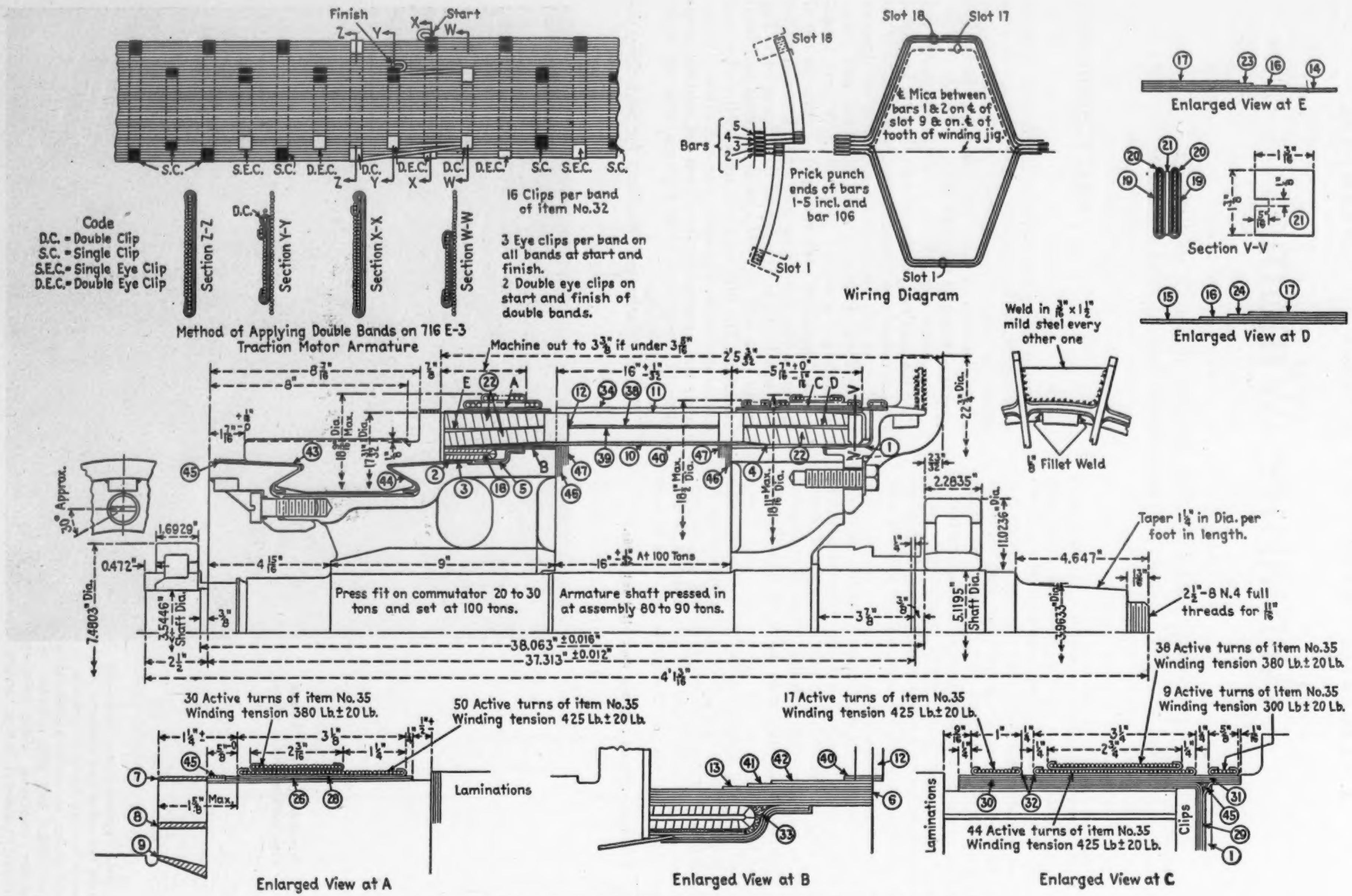


Fig. 1—Layout for a General Electric motor armature showing each step in the placing of coils, insulation and banding—The details are given in the table

Data required for following instructions shown in the layout on the facing page—The numbers in the table correspond to those which are circled in the diagram

Item No.	Descripton	Material	Size
1	Flange insulating ring P. E.	G. E. Co. 2702672	1 piece
2	Head insulating ring C. E. (1 layer)	Mould. mica	.020"x1 15/16"x24" (2 pcs.)
3	Head insulating ring C. E. (2 layers)	Mould. mica	.020"x1 3/4"x24" (4 pcs.)
4	Head insulating ring P. E. (3 layers)	Mould. mica	.030"x4 7/16"x24" (6 pcs.)
5	Head insulating ring com. end	G. E. Co. 2702674	1 set—2 layers
6	Head insulating ring C. E. (3 layers)	Mould. mica	.020"x4 1/2"x26" (6 pcs.)
7	Commutator filler	G. E. Co. 756697 P 16	210 pieces
8	Commutator filler	G E. Co. 756697 P 17	210 pieces
9	Commutator filler	G. E. Co. 756697 P 18	210 pieces
10	Slot strip (lower) 1 layer	Flex. mica	.010"x11/32"x14 3/4" (70 pieces)
11	Slot strip (top) (1 layer)	Mould. mica	To suit x 11/32" x 16 1/4" (70 pcs.)
12	U piece at slot ends	Flex. mica	.010"x1"x5" (140 pcs.)
13	Filler strip (1 layer)	Flex. mica	.010"x3"x24" (2 pcs.)
14	Ins. between upper & lower bars (C. E. 1 layer)	Flex. mica	.020"x3N"x28" (2 pcs.)
15	Ins. between upper & lower bars (P. E.) 1 layer	Flex. mica	.020"x4 1/8"x28" (2 pcs.)
16	Ins. between upper & lower bars (1 layer each end)	Flex. mica	.020"x3 1/4"x28" (4 pcs.)
17	Ins. between upper & lower bars (2 layers each end)	Flex. mica	.15"x3"x28" (8 pcs.)
18	Ins. in equal winding (3 layers)	Flex. mica	.020"x2 3/8"x25" (6 pcs.)
19	Ins. around bottom of clip P. E.	Flex. mica	.010"x1"x2 7/8" (210 pcs.)
20	Ins. around top of clip P. E.	Flex. mica	.010"x1"x1 5/8" (210 pcs.)
21	Insul. between clips P. E.	Mould. piea	.020"x1 3/8"x1 3/16" (210 pcs)
22	Insul. between coil bundles top & bottom each end	Flex. mica	.010"x5/8"x2" (140 pcs.)
23	Insulation between coils (1 layer)	Flex. mica	.020"x2 3/4"x28" (2 pcs.)
24	Insulation between coils (1 layer)	Flex. mica	.020"x2 1/2"x28" (2 pcs.)
25	....	....	....
26	Insulation over end windings commutator end (2 layers—4 pcs.)	Flex. mca	.020"x3 5/8"x30" (2 layers)
27	....	....	....
28	Binding base (2 pcs.)	Treated asb.	.030"x3 5/8"x30" (1 layer)
29	Insulation over clips (Pinion end shingled 2/3 lap)	Flex. mica	.015"x2 1/2"x6 1/2" (75 pcs.)
30	Insul. over end windings (pinion end—1 layer)	Flex. mica	.015"x5 7/8"x32" (2 pcs.)
31	Binding base—pinion end	Treated asb.	.030"x5 7/8"x62" (1 pc.)
32	Binding clips	Bright tin	.016"x19/32"x to suit (1 sq. ft.)
33	Filler putty	Made from Zonite and 1154 Glyptol and 1154F thinner	
34	Slot wedges	G. E. Co. 2706848	(280 pcs.)
35	Binding wire	13 GA magnetic	
36	Binder over commutator mica	Armature cord	....
37	Protective compound (over binder on commutator mica)	Filling compound	....
38	Slot strip (center)	Flex. mica	.005"x11/32"x17 1/2" (70 pcs.—1 layer)
39	Slot strip (center)	Flex. mica	.010"x11/32"x17" (70 pcs.—1 layer)
40	Slot strip (lower)	Flex. mica	.010"x11/32"x17" (110 pcs.)
41	Filler strip (1 layer)	Flex. mica	.020"x2 1/2"x24" (2 pcs.)
42	Filler strip (1 layer)	Flex. mica	.020"±2 1/2"x24" (2 pcs.)
43	Mica V ring	G. E. Co. 2717826	....
44	Mica V ring	G. E. Co. 2717827	....
45	Glass string	National E. C. Co. T-3-6 3/64"	....
46	Punchings (620 pcs.)	No. 2735963 P 1	620 ±layers
47	Punchings (8 pcs.)	No. 2735963 P 2	4 layers

more divisions you can make, and the more divisions, the more efficiency. It will surprise you how quickly you can teach a man if he only has one operation to perform, and if you can add a little incentive by a bonus for finishing more than a certain number a week, you can easily save money (as much as 50 per cent) on rewinding armatures and do it with unskilled men.

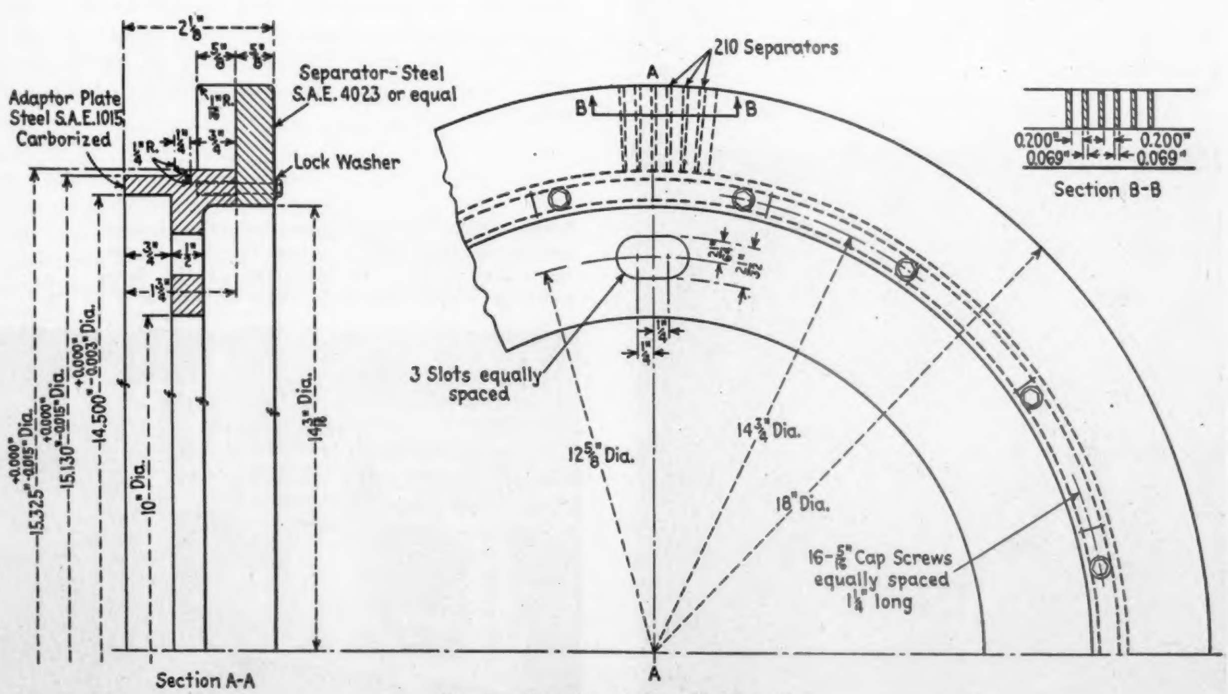


Fig. 2—Details of the winding jig

In our experience, the biggest problem was training the men to apply the armature coils. After trying several different methods, we developed a fixture such as shown in the photograph, on an armature that has been wound. This fixture or winding jig is shown in detail in Figure 2 and has solved this problem completely. We had to insist on each coil being exactly preshaped so that once it was placed in the armature that no shaping would be required. We now have such a coil and practically all a man has to do is drive the coil in the slot and it is no job to train any man to do this job.

There is another detail which is important. If you will look closely at the photograph, you will notice that wedges do not line up, but instead, are staggered. A short wedge (wedges are cut in two) is placed in every other slot, and this arrangement will keep the laminations from separating at the edge of the wedge. If you look closely at an armature that has been in service you will nearly always find that laminations are working and that a definite opening or separation may be seen at the edge of the wedge. By staggering the wedges around the armature, they will help tie the lamination together and avoid this separation.

Induction Heater and Mechanical Puller

A combination induction heater and mechanical puller for removing and applying roller bearing sleeves and inner races has been built at the Sacramento, Calif., shops of the Southern Pacific. It consists of a steel frame mounted on three rubber-tired wheels and carrying a vertically-adjustable support for an induction heater and air motor drive for a square-thread screw and ball-bearing center plate which exerts pressure on the axle-end while a circular pulling plate at the extreme right pulls off the sleeve. This assures quick and easy removal of the sleeve which may stick even though slightly expanded.

The induction heater consists of a coil of 200 turns of No. 8 four-mesh copper wire applied to a Bakelite core 10 in. long by 8 in. inside and 10½ in. outside diameters. For heating purposes, 440-volt, 60-cycle alternating current is supplied to this coil through suitable leads, and a magnetic switch, controlled by a push button interlocked with an arm of the air motor serves to protect the coil.

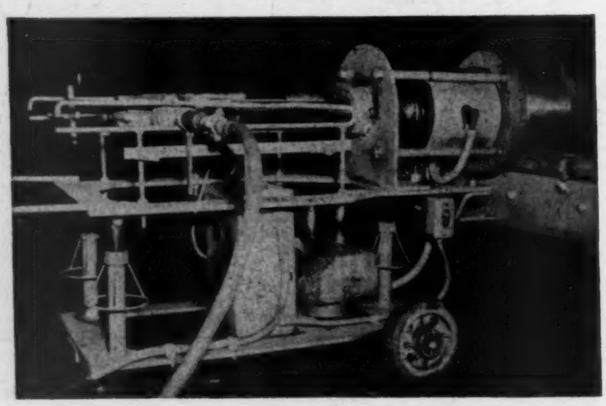
The induction coil is supported between a stationary plate, bored and threaded to guide the 2½-in. by 24-in. square-thread screw and a split and hinged pulling plate, 14⅜ in. in diameter by 1⅛ in. thick, at the extreme right which is locked around the car axle and used to bring pressure on the sleeve by action of the motor-driven screw with its ball-bearing center plate. The four pulling bolts, 1 in. by 19 in., are fixed in the left plate and have easily removable nuts which hold the pulling plate at the right after it has been applied around the axle and over the bolt ends. When not in use, this pulling plate is suspended under the steel frame near where it is used, as shown in the view at the left. In this way, the plate always stays with the machine and is conveniently available when needed.

This machine is roughly 50 in. long by 20 in. wide and 27 in. high. Being mounted on wheels it can be readily pushed from one end of the axle rack to the other in the wheel shop. It also moves slightly in normal operation. For example, in pushing on the end of a fixed axle, the machine backs slowly outward as the sleeve is pulled off. A vertical adjustment of about 5 in. by means of the hand nuts shown takes care of any slight difference in height of the axles.

When removing a sleeve, the machine is set up and about 60 to 70 amp. applied to the coil for 35 to 40 sec., dependant on the axle size. The actual temperature is generally less than 300 deg. F., or not enough to blue or straw the steel. The average removal time is one minute.

In applying a roller bearing sleeve, it is simply inserted in the induction coil, about 80 amp. supplied and the sleeve expanded enough to be slipped on the axle without supplementary pressure. It takes just about the same time to apply as to remove a roller bearing sleeve with this machine, namely one minute.

Left:—Roller-bearing sleeve induction heater and mechanical puller, ready for shop movement and (below) in operation at the Sacramento wheel and axle shop of the S. P.



Traction Motor Maintenance in a Small Shop

Florida East Coast's Buena Vista shops at Miami employ simplified facilities to maintain the electrical equipment of 44 Diesel-electric locomotive units

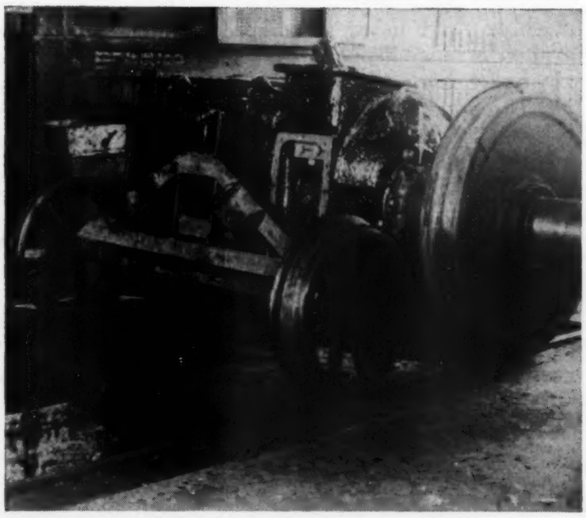


Fig. 1—Two-wheeled dolly used for moving traction motors from the drop pit to the electrical shop

By *F. A. Totams**

The report of the Joint Committee on Motors and Controls, Electrical Sections, Mechanical and Engineering Divisions, A.A.R., has set a minimum of 20 units per month as the figure that would justify the erection of an electrical repair shop and for instituting a production line maintenance and overhaul program of traction motors, auxiliary generators and main generators from the Diesel-electric locomotives maintained by the shop. Otherwise, the committee recommends sending equipment to an outside repair shop for maintenance.

The production line maintenance shop involves an immense outlay of money for armature winding equipment, banding lathes, balancing machine, vacuum impregnator, bake oven, material handling equipment, small tools and equipment, labor and supervision. Balanced against this cost, when the work is sent to an outside shop, is the cost of transportation to and from the outside shop, the increased investment in spare equipment to compensate for the time lost in transportation to and from the outside shop, and little or no knowledge of how the equipment is standing up under the operating conditions or what are the main causes of equipment failures.

Considerable satisfactory motor maintenance work can be performed in the shops of a smaller railroad by utilizing existing facilities plus a little ingenuity and cooperation between the supervisors and the men who perform the actual work.

The Florida East Coast has, at present, 26 passenger units, 12 freight units, and 6 branch line switchers in operation. All motor changes are cared for at the Buena Vista Shops in Miami, Florida, and during the last three year period, 374 motors were changed out for various causes. Out of these, 66 armatures required factory attention, and 10 complete motors which the local shops were not equipped to handle, were returned to the manufacturer for mechanical repairs. The balance of these motors were returned to useful service after being overhauled in

Fig. 2—While it is being overhauled, the field frame is placed on a cleaning rack made of scrap rails — The operation shown consists of slipping a hose over a traction motor lead

* Electrician, Florida East Coast Railway, Miami, Fla.

Fig. 3—Before the armature is dipped, the pinion-end bands are wrapped with cotton tape to prevent an accumulation of varnish at this end of the armature

our own shops. All this was accomplished with very limited facilities which should be available on any railroad operating Diesel locomotives.

A portion of the machine shop has been set aside for this work, and a track section with a pit within the shop is served from the turntable. The motor and wheels are carried into the shop from the drop pit on a two-wheel dolly. There the wheels are dismounted and the motor torn down.

Frame Reconditioning

The field frame is placed on a cleaning rack which was constructed out of scrap rails as shown in Fig. 1. The motor exterior is dry scraped to remove road dirt and grease, the inspection covers are removed and the exterior and interior blown thoroughly with compressed air. The accumulation of crater compound which collects on the ventilating screens on the pinion end is removed by burning it out with a gas torch, and then scraping the charred compound off with scrapers. All of the dry material is swept up and then the frame is washed inside and out with cleaning fluid using a compressed air jet with a syphon arrangement that mixes the cleaner with the air under high pressure providing a high velocity jet. Three gallons of this cleaner is sufficient to wash the average motor frame. All excess liquid is blown off, using the air jet alone, and the motor frame is allowed to stand alone a short time to allow the cleaner on the frame to evaporate. The brush holders are then removed and given further cleaning in a flat pan of cleaner.

The frame is then given a close inspection, particular attention being paid to the tightness of field coils, coil to coil connections, the lacing of coil connection to the field frame, the condition of the brush holder connection terminals and the mechanical condition of the field coil insulation.

The traction motor lead hose is removed and the condition of the motor cables determined. Shrinkage of the insulation at the connectors is built up by using friction tape and black air dry varnish to prevent an accumulation of road dirt where the lead hose and micarta quills are joined. New leads are installed whenever necessary and the clasp connectors replaced if bruised or damaged in any way. A soldering trans-

Fig. 4—There is a vertical hinge at the back of the baking oven and the two halves may be swung apart on rollers to permit apparatus to be placed in or removed from the oven

former with tongs is almost a necessity in replacing these clasp connectors and in making coil connection repairs in the field frame.

The field coil insulation resistance is then measured with a megger tester. It should read 5 megohms or better. If the field frame passes these tests, it is ready for repainting. During this operation, masking tape is applied over the brush holder terminal connections, over the brush box stud mounting blocks and all bearing retainer fit surfaces which are carefully covered. A pair of discarded suspension bearing shells are put in place to mask the mechanical fit of those parts.

The interior is then spray-painted using an external mix spray gun. All inspection covers are put in place temporarily and the exterior sprayed with black hard drying enamel and allowed to dry.

The brush holders are checked for spring tension, using an accurately scaled spring balance, and carefully inspected for cracked porcelains or porcelains burned from flashovers. The carbonways are measured for excessive wear and for distortion. The brush spring shunts are inspected for broken strands and for loose soldered connections to the body of the brush box.

After this inspection, they are hi-potted for one minute at 1,500 volts, and are then ready for re-installation in the field frame.

Inspection covers are stripped of old felts, and placed in a lye vat and boiled until clean. They are steamed and washed in clear water, dried and painted inside, and new felt gaskets are applied.

As soon as the field frame is dry, the masking tape is stripped off and the reconditioned brush boxes are installed. The maximum spacing between opposite boxes should be maintained to allow ample clearance when installing the armature in the field frame during the final assembly of the motor. The proper brush holder spacing is determined after the armature is in place and before installing the brushes. After a one minute hi-pot of 1,500 volts to ground, the field frame is removed to the assembly floor.

Armature Overhaul

In the meantime, the armature has been stripped of all bearing races and delivered to the electrical section for processing. A low wagon with eight-inch steel wheels and with wooden blocks cut to the same radius as the armature laminations secured to the wagon bed is very necessary for safely handling the armature from one part of the shop to another.

The armature is thoroughly blown out with the high velocity air jet to remove road dust from the spider, commutator support and from the ventilating ducts. It is then meggered, and the resistance should read 5 megohms or better. Using the same high velocity air jet with syphon attachment, the armature is thoroughly washed with a cleaner. All excess liquid is blown off, after which the armature is given a visual inspection to locate loose bands, loose or broken wedges, loose balance weights, broken coil support castings and any other mechanical damage. If found satisfactory, it is turned to a vertical position and placed in the bake oven for an eight-hour period.

There is considerable controversy over the use of vacuum impregnation at this stage of the overhauling and, most certainly, if you have the equipment available, it is advantageous to use it.

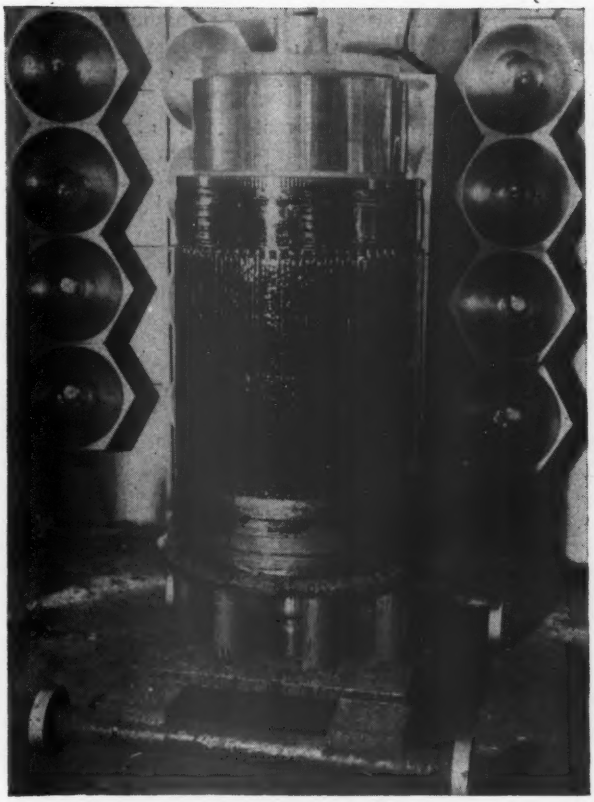


Fig. 5—A traction motor armature on a dolly inside the baking oven

The vacuum tank with pressure treatment for armatures is desirable in the initial treatment of a new winding in an armature where the impregnating varnish must be forced into all voids and spaces in the winding assembly. But a winding that has had the proper initial impregnation can be dipped in a good grade of baking varnish and, if the viscosity of the varnish is carefully controlled, satisfactory results can be obtained. The armature should be allowed to soak until all bubbling ceases, then removed from the varnish, allowed to drain and air dry before baking, and then baked properly.

We have used a baking varnish which has a specific gravity of .8500 at 60 deg. F. The varnish is kept within the limits of .8500 and .8756 specific gravity by the addition of benzine thinner, and frequent checking with a hydrometer and a thermometer reading in deg. F. We use a hydrometer calibrated to 60 deg. F. and ranging from 29 deg. F. to 41 deg. A.P.I., and then correcting to 60 deg. F. specific gravity by means of A.P.I. handbook tables.

After the cleaned armature has been baked and cooled to room temperature, it is hung vertically from the commutator end and immersed into the varnish tank up to the commutator neck. Extreme care should be exercised in this operation as the varnish level rises very rapidly and the commutator may be covered with varnish before the operator realizes it. Immersion from 15 to 30 minutes is sometimes necessary before bubbling ceases, then the armature is lifted out and suspended over the tank to drain. Benzine and a paint brush are used to remove the varnish from the pinion fit, grease retainers and bearing fit on the shaft before the armature is allowed

to air dry. As a safety precaution goggles should be used when cleaning with the benzine as a small amount splashed into the eye is not only very painful but a hazard to sight.

The practice of going direct from the bake oven to an open varnish tank and dipping a hot armature is not conducive to best results as the hot armature causes the thinner to boil, and this boiling action prevents the varnish from entering into the minute openings and making up for the shrinkage that has occurred in the insulation from repeated heating and cooling cycles during normal operation of the motor. Immediate baking after dipping at room temperature, without first air drying, will also result in voids being caused by the thinner being forced out by boiling under heat instead of gradually evaporating as the varnish air dries.

The dipping vat was constructed from a 50-gal. oil drum with an extension section 12 in. long, welded to it. The lid is kept in place with a seal of masking tape each time after it is used to prevent evaporation of the thinner and as a means of reducing the fire hazard. The vat should be marked and treated as a fire hazard and lights and fires kept a safe distance away whenever the tank is open for use.

In all this dipping, drying and baking process, the armature is kept in a vertical position in order not to destroy its mechanical balance. If the armature were turned horizontally after dipping and for baking, the varnish would settle to the low side and a definite unbalanced condition would result, sufficient to cause vibration at normal operating speeds.

In the vertical drying position, an excess of varnish tends to accumulate on the pinion end bands in the form of runs and blisters. This is prevented by wrapping the lower end from the edge of the laminations to the coil support ring with 1½-in. cotton tape before dipping and allowing it to remain on the armature until after it has been baked. Figure 3 shows the cotton tape being put in place just before the armature is dipped. After baking, it is removed and it carries all the excess drippings of varnish with it.

Infra-Red Baking Oven

The bake oven is shop made and uses 48 infrared ray reflector units, rated 250 watts each, and mounted in sections of 4 as shown in Figs. 4 and 5. An average of 24 hours total baking time is required for each armature, and as the oven draws 12 kw.-hr. per hour the cost of baking can be calculated.

After baking for 16 hours the armature is allowed to cool, and then is carried to the lathe for turning and grinding the commutator. An inner bearing raceway is shrunk to the shaft on the commutator end and a commutator end roller bearing, made up in a holder to fit the tail stock of the lathe, takes the place of a center during the turning and grinding of the commutator. After it has been turned true, two 1-in. x 2-in. fine commutator stones in a fixed holder are held in the tool post of the lathe and the commutator finished by grinding. All turning chips should be brushed from the commutator slots before attempting to make the finish grind.

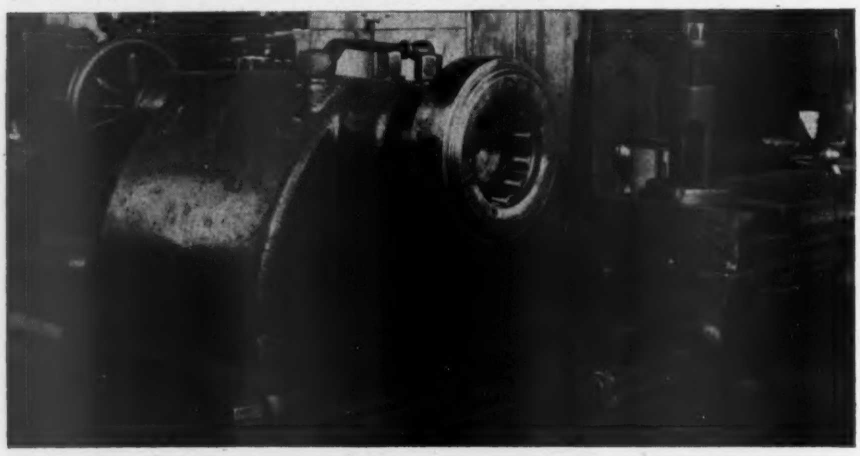


Fig. 6—A roller bearing is mounted in the tail stock of the lathe for turning and grinding commutators

Figure 6 shows the commutator end roller bearing holder mounted in the tail stock of the lathe. This shop-made fixture gives the equivalent condition of turning and grinding the armature in its own bearings and has resulted in excellent commutator surfaces on overhauled equipment since it has been in use. A new bearing taken from stock was used when making up this assembly.

After removal from the lathe, the armature is stripped of the bearing raceway, and carried to an armature stand where the burrs on the trailing edges of the commutator bars are removed by means of a hand slotting tool. Next, the risers, the string band and the commutator support spider are painted with red enamel. A most satisfactory job is obtained by masking the commutator surface, and the barrel of the armature, and painting with a spray gun. The masking tape should not be allowed to remain on the commutator any longer than necessary to spray the job, as it will leave a slightly gummy surface that picks up dust and carbon powder when the brushes are sanded into their final brush fit.

A hi-pot test of 1,500 volts for one minute is next made on the reconditioned armature, after which it is ready for re-assembly in the reconditioned frame. A shield of 1/16-in. grey fiber, 7-in. wide is wrapped around the commutator and secured with masking tape to protect it from any scratches or bruises, and this should remain in place during assembly and until the brush boxes are set for their proper spacing in the motor.

Grounded field frames, and field frames with loose field coils, can be repaired without an excessive out-

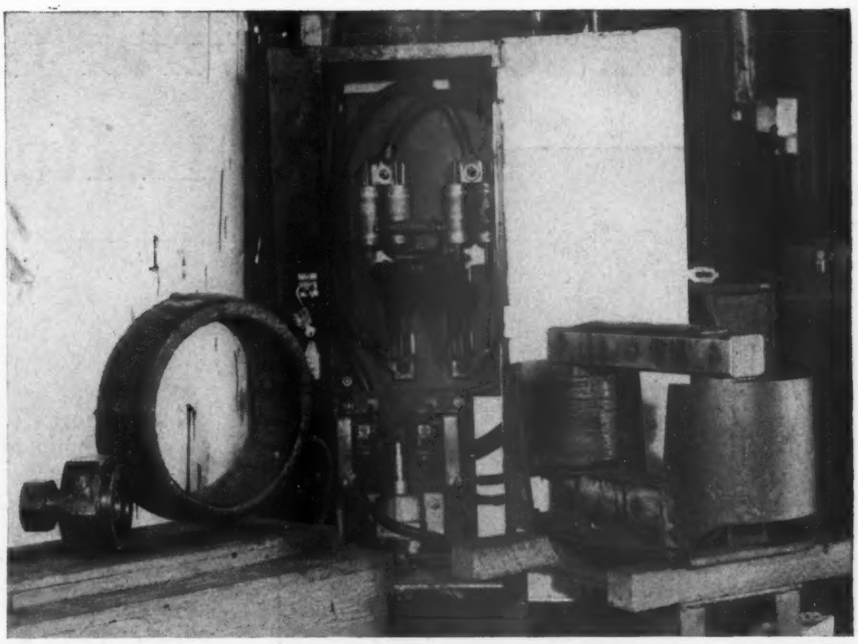


Fig. 7—Pinions are removed and applied by induction heating with the equipment shown—The heating coil and puller for removing pinions is shown at the left and the pinion heater for applying pinions at the right

lay for tools or equipment. The most essential item is some means of rotating the field frame in order to place the field pole that is being worked on into a convenient position. Two 42-in. circles of ½-in. boiler plate were flame cut, a concentric circular opening cut from the center of one, and a 12-in. concentric circular opening cut from the center of the other. They were then drilled to match the drilling of the bearing spider support bolt holes on the commutator end of the field frame for one plate and to match the end bell holding bolt holes on the pinion end for the other, and then bolted to the field frame. A fabricated steel rack was made in the shop, which consists of double-flanged rollers spaced 46 in. apart on center lines, and 24 in. apart center to center of the supporting shafts—the rollers being at a height of 30 in. from the floor. The rack is of all-welded construction. The field frame with the circular plates attached and be readily rotated on the rollers to position it for the most convenient removal and re-application of both main fields and interpoles. This rotation can be easily accomplished by wrapping a steel cable or chain around the frame and turning it by pulling upward with an overhead crane or hoist.

An overhead crane or electric hoists on jib crane arms are an absolute necessity for handling this type of repair. The wheel dismounting and wheel mounting area should be served with a crane of at least three tons' capacity, and the electrical repair section served with its own crane, which may be of lighter capacity. A 1½-ton hoist with rope operated control or pendant pushbutton control is sufficient to handle armatures or field frame separately. The dollies shown in Figs. 3, 4 and 5, used to support the armatures during the baking operations, and for moving in and out of the bake oven, are entirely shop made. The wheels are discarded auxiliary generator ball bearings, (the shield type having been found most satisfactory), with their inner races welded to the seamless tubing used as shafts. The balance of the construction is quite plainly shown in the illustrations and can be used as a pattern for shop manufacture. A number of these dollies are a great help in avoiding unnecessary handling of armatures and one should also be constructed as a platform for moving the varnish barrel out of the way when not in use.

Figure 1 shows the dolly used to move mounted motors to and from the drop table. The feature of most interest is the method used to attach this dolly to the mounted motor. Two eyes, cut from ½-in. flat steel are welded to 1¼-in. studs and passed through openings in the brackets welded to the wishbone frame of the dolly. These eyes are slipped over the bottom nuts on the interpole holding studs on the blower side of the motor, then the nuts on the 1¼-in. studs are pulled up tight which draws the dolly snug against the motor frame. A steel block welded to the upright braces rests on top of the support spring nose and the combination of this block and the tension on the eye bolts holds the dolly safely and securely to the motor frame.

Figure 7 shows the induction heater used for removing 22-tooth motor pinions, and the control panel designed to handle the heavy current, 220-volt circuit which supplies its power. A double-pole 800-amp. fused knife switch and a traction motor field shunting contactor are mounted in the steel cabinet as shown in the illustration. The air line for operating the contactor is carried into the cabinet and a ¼-in. shut-off cock, drilled for relief bleeding of the contactor operating cylinder each time the valve is shut off, was placed in a readily accessible location. This heater was constructed from an idea presented in the Electrical Section of this magazine some time ago, and has proven very satisfactory.

Credit for the development and manufacture of the equipment shown cannot be given to any one individual or to any particular group. It has been the result of cooperation between the mechanics and their supervisors, with a willingness on the part of both to experiment, and to try out an idea before condemning it as unworkable. The men in the boiler shop, the machine shop, the blacksmith shop, the pipe and sheet metal shop, and the electrical shop, have all pooled their ingenuity and their resourcefulness toward the manufacture of the equipment described.

Maintenance of Converter Governors in Radio Service

By *John G. Weber**

Fig. 1—For making the adjustments the governor is mounted on a stub shaft which is held in a vise—The stub shaft takes the place of the armature shaft

THE Denver and Rio Grande Western has had 30 Diesel-electric freight locomotive units equipped with radio since 1946, using the Eicor model ML6120/20-22 converter as the source of a.c. power. The converter uses as its driving power a fluctuating d.c. voltage ranging from 58 to 78 volts. In order to hold radio maintenance costs to a minimum, the converter is required to hold its voltage to plus or minus three per cent.

Maintaining close output regulation in the face of very wide input ranges becomes the job of the converter governor. In our three years' experience with the Eicor converter, it has become evident that by far the greatest percentage of maintenance on the unit has been on the governor itself; and, because of the importance of the proper functioning of the governor, studies were made in an effort to better adjust, regulate and repair the device. It was realized that any progress made would be reflected in less radio communication outage and lower radio maintenance costs.

It is the purpose of this article to discuss the governor as produced by the Eicor Manufacturing Corporation for use on its model ML6120/20-22 converter, and to show how static adjustment can be properly accomplished in the average railroad shop. It is far less expensive to do the work than to replace governors as a unit. And it is certainly well worth a considerable amount of time and money to hold the output voltage regulation to narrow limits by properly adjusting the governors.

The converter operates on a rated 64 volts, d.c.,

* Electrician, Denver & Rio Grande Western.

Fig. 2—With the proper amount of weight suspended from the lower contact, the lower adjustment screw is turned until it just touches the lower spring

Fig. 3—The second operation consists of suspending a larger weight from the end of the upper spring, and then adjusting the upper spring until the contacts just touch

Fig. 4—The air gap is then set by means of a .030-in. feeler gauge and turning of the upper adjustment screw

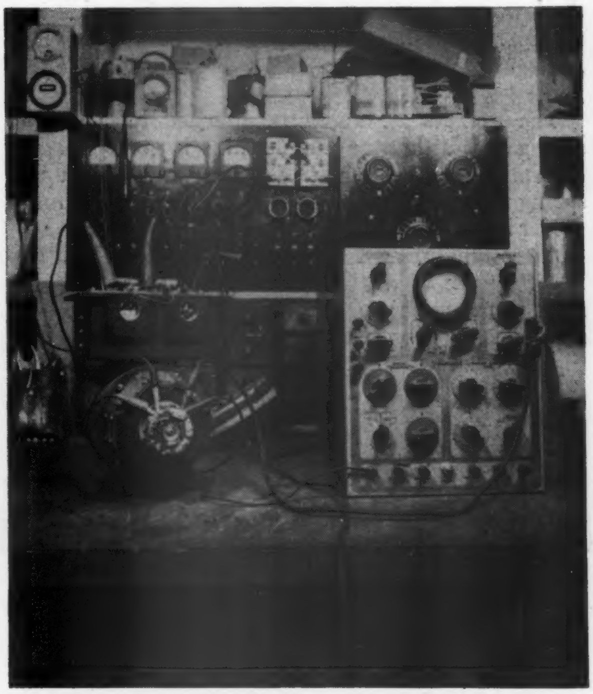


Fig. 6—After the governor is adjusted, it is mounted on a converter and if desired, tests for voltage and current output, frequency, wave form and regulation may be made on this test panel

and puts out 115-volt, a.c., 60-cycle, single-phase current, turning at 3,600 r.p.m. The input voltage is handled by its armature using separate fields. The a.c. output is also separately excited with the revolving field producing its output through collector rings.

Speed, and consequently voltage and frequency, is regulated by the use of a centrifugal electrical governor mounted on the end of the armature shaft. Accurate adjustment of spring tension, air gap and relative setting of contact points on the governor is essential for desired performance.

Until recently all adjustments were made without removal of the governor, virtually by trial and error. Now, when output voltage is in error, the governor is replaced by a repaired one, and the defective governor goes to the shop bench for overhaul and proper adjustment and regulation. The static adjustment, as developed by the author, is accomplished by using a stub shaft to mount the governor (in lieu of its armature) and the shaft set in a vise (see Fig. 1).

Procedure for making the required adjustments is as follows:

With the governor mounted as in Fig. 1, loosen the upper adjustment screw (nearest the shaft), which will allow enough gap to remove the contacts for cleaning or replacement. Filing and burnishing can be better accomplished while the points are removed.

After contacts have been replaced, a supporting member for weights is placed on the lower contact, together with its weights, the total value of which was determined by previous experiment.* The lower adjustment screw is then adjusted until it just touches

* Values of weights can be obtained from the author.

Fig. 5—Equipment used to adjust the governors

the lower spring as pictured in Fig. 2. Note that it is necessary that the lower spring must now be in a horizontal position, adjusting the position of the governor in the vise if necessary.

The weights are similarly attached to the upper spring except that the weight value is greater (again determined by previous experiment). The upper spring is then adjusted until the contacts just touch (see Fig. 3).

After the spring tension is adjusted, the air gap is set by use of a .030-in. feeler gauge and adjustment of the upper screw (Fig. 4). Locknuts on both adjustment screws must, of course, then be tightened. Figure 5 shows all necessary equipment to adjust the governors. The rack contains various lead weights as made up in the shops; the strap and weight support were also made by the author. The other tools are standard, as pictured.

If it be desired to further test the governor, it can be regularly mounted on a converter and any voltage, current, frequency, sine wave or regulation data can be observed by use of a proper test panel as shown in Fig. 6, where a variable power source, variable load and all metering is available.

The method of governor maintenance just discussed has proven highly successful on our railroad and the time and study consumed in its development has been justified many times over.

CONSULTING DEPARTMENT

Mercury Tube Thermostats

On certain of our cars we have frequent trouble with the mercury tube thermostats; whereas on other cars of an identical design we have practically no trouble with the same kind of thermostats. Can anyone suggest why we have a lot of trouble on some cars, and no trouble on similar cars?

Trouble Can Usually Be Traced to Grounds

To completely analyze the mercury tube thermostat situation with relation to service on railway passenger cars, it is necessary to understand that the most important failure of mercury tube thermostats is the separation of the mercury column. This condition causes a lack of electrical continuity when the tube is at the setting temperature of the thermostat. In some few cases, the failure is not complete and the mercury tube may make electrical contact at some higher temperature. This change in setting is caused by the separation of a small quantity of mercury which remains above the main mercury column.

The fragility of mercury tube thermostats immediately suggests that separations may be caused by mechanical shock. This cause of failure has been largely discounted during the past few years. Design changes in mercury tubes, which have improved shock resistance several hundred per cent, have not appreciably decreased mercury tube failures in actual railroad service.

A more logical solution to the question, "Why are there mercury tube thermostat failures on some cars and none on other cars of identical design," has been arrived at by checking maintenance and service records of several of the larger railroads. It was found that each railroad that had mercury tube thermostat failures on one design of cars, had the highest percentage of failures on a small percentage of the total number of cars. From this it was concluded that there must be a percentage of troublesome cars in each design series. Investigating further, it was shown that the troublesome cars had one common fault, namely, grounds or electrical leakage between the positive and negative of the supply system.

Most railroad men agree that measurable grounds, of about 500,000 ohms or higher, exist on all railway passenger cars and that it is next to impossible to remove the ground condition completely, to increase its resistance to 5,000,000 ohms or higher. The fact that a car has a ground condition is not in itself, too important, the seriousness depends on whether the ground is of a high or low resistance value. We will therefore assume that all cars have some measurable ground condition. When we think in terms of a ground, we will mean low resistance grounds.

We know that with a low resistance ground of a value equal to the total resistance of a mercury tube circuit, paralleling the mercury tube circuit, it is possible in some cases to double the current through the mercury tube contacts. Mercury tube thermostats are very sensitive to electrical overloads and service life may be reduced to a few cycles if a large electrical overload is applied. On the other hand, a ground of high resistance value has little or no effect on the electrical characteristics of the mercury tube circuits.

To consider an actual case, one eastern railroad had a series of 46 passenger coaches with the same equipment and identical design. Of these cars, more than 85 per cent of the mercury tube failures for one season were on 9 cars. That is, 85 per cent of the failures were on 20 per cent of the cars. These cars, when checked, all were found to have bad ground conditions in various parts of the cars or in electrical equipment. Several of these cars had thermostat failures each trip; others failed every other trip. When the grounds were removed, the mercury tube failures diminished radically or stopped completely.

Most railroads are aware of the seriousness of grounds on passenger cars, and have incorporated a daily, weekly or trip check to help eliminate some of the electrical equipment failures. Railroads that consistently check for grounds show a low percentage of mercury tube failures.

R. R. Paget
Transportation Controls Division
Fulton Sylphon

EDITORIALS

Should Mileage Be Stretched Out?

In any consideration of classified repairs to either steam or Diesel power the determination of the mileage to be run between such repairs is of critical importance. So is the subject itself, and not only as it concerns steam power. The increased sympathy toward adapting classified repairs to Diesel locomotives and the present extent to which this is being done makes imperative the weighing of the many and complex factors involved in the twofold decision of whether or not to make class repairs and, if so, at what frequency.

The same problem arises in connection with Diesel classified repairs that has always existed with steam power, and, if anything, to a greater extent. The problem is whether to set the highest attainable mileage between class repairs, or whether it is better to give them more frequently on the theory that the work must be done anyway, and that it is cheaper to do it in the back shop than in the roundhouse. Unfortunately, there seems to be no answer that can be considered at all definite.

One road runs modernized steam locomotives 400,000 miles between Class 3 repairs, and gives no Class 5's in between. Another runs modern locomotives only a little over 200,000 miles between Class 3's, and gives at least one intermediate Class 5. Both lines have an excellent steam operating efficiency with extremely high availability. Which practice is the more sound, and the cheaper when all factors are considered, is impossible to determine because of the differences in the operating conditions and in the design of the locomotives, although the line that extends the repair period does not seem to be unduly burdened with work in the roundhouse.

As desirable as the proper determination of mileage between classified repairs for steam power is, it is doubly so for Diesels. While it is no cheap item to replace steam-locomotive cylinder packing or bushings, shoes and wedges, crank pins, etc., when these parts have a fair percentage of useful life remaining, it is but a fraction of the cost of replacing the multitude of high-precision parts that make up the Diesel locomotive. Discarding these parts when any appreciable amount of wear life remains can be a very costly practice. At the same time no risk can be taken of running the parts beyond their reliable service life because to do so would invite road failures and loss of availability to a highly expensive and valuable piece of equipment.

Because of the dual, and to some extent opposing, requirements of operating motive power at the lowest possible repair cost and at the highest degree of reliability, a shopping schedule that most nearly meets the optimum requirements of both objectives can be arrived at only after a thorough study of the service lives of parts, the renewal of which cannot readily be effected during service layovers.

Lubricating Car Journals

Practices employed by the railroads in lubricating car journals equipped with solid-type bearings present some complex problems which have been difficult of solution because the variables encountered in the load-speed phase of operating railroad equipment and the extremes of atmospheric conditions cannot be predicted or controlled.

Journal boxes on interchange freight equipment are periodically repacked within a prescribed time of 15 months. It is, therefore, obvious that the oil and waste applied to any journal box must operate for the four seasons of the year. A glance at the operating record of any railroad will show that cases of journal heating increase in number as the extremes of atmospheric temperatures are approached. This means that, in a large section of the country, the yearly hot-box curve reaches a single peak in July or August and, in the extreme northern section of the country, it is not unusual for a second peak in the bearing failure curve to occur some time during the winter.

During periods of extreme low temperatures railroads are confronted with an indirect rather than a direct lubrication problem. From the operating records of any railroad it is noted that as ambient temperatures fall to a point approaching freezing, the curve of bearing failures also goes down. Below a point in the region of zero, however, the physical characteristics of the average oil changes from a liquid to a semi-solid and the packing becomes a mass of jelly-like substance which, under certain conditions, will not stay in place in the box; and, it is during this time of zero or lower temperatures that railroads in the northern portion of the country experience their most severe trouble.

Through the years it has been necessary to compromise good lubrication engineering with operating expediencies. Interchange of equipment has been a factor in keeping individual railroads from reaching maximum lubricating efficiency with the available material. The use of two-season oils, which always overlap in actual service, has helped to raise the fail-

ure records. The so-called one-season oil is largely a misnomer, thus far, but presents the only practical solution to the problem of waste-packed journal bearings regardless of seasonal atmospheric conditions.

In order to maintain the highest degree of lubrication economy and because renovated car oil is approximately 75 per cent of the total oil used to lubricate the country's rolling stock, the logical starting point in solving this problem is to make the renovated oil by blending and compounding in the renovating plant into a one-season oil that approaches the ideal car oil. Renovation of journal packing has been accepted as an economic necessity. By utilizing the facilities of the modern renovating plant for blending and compounding car oil, renovation will become the principal source of efficient car lubricants at the lowest possible price.

For winter operation, therefore, it is apparent that railroads require an oil which will remain liquid at the lowest temperatures that may be encountered and still have sufficient viscosity and film strength to support the load under fluid film lubrication and boundary lubrication where necessary.

Traction Motor Bearings

Traction motor bearing practices on various railroads are quite definitely inconsistent. Some of the differences are due to variations in the manner in which locomotives are used. More are apparently due to differences of opinion concerning what constitutes good practice.

One railroad, for example, replaces traction-motor bearings with new ones at each 250,000-mile overhaul. In this case reconditioned bearings are looked upon with suspicion. Another road replaces new bearings with reconditioned bearings, arguing that the reconditioned are exactly as good as new and adding that bearings should not be inspected, cleaned and relubricated by the railroad since the insurance value of the reconditioned bearing outweighs the savings effected by reusing a bearing. It is maintained that the cost of one bearing failure will pay for a lot of reconditioning.

A number of railroads inspect and clean bearings and replace them in service. One of these takes bearings used in passenger service and applies them to freight locomotives. To insure distribution of wear, outer races are etched when first placed in service and when reapplied the outer race is turned 90 deg. from its position in the original installation.

Bearing manufacturers are now offering bearings which should serve for a million miles without overhaul. One railroad operator on hearing of this said, "Why should I buy a million-mile bearing since we pull them at each 300,000-mile overhaul and I am afraid to replace a bearing which has been used."

On the other hand, some operators believe it may be practicable to run a bearing a million miles and to recondition the bearing twice, thus obtaining a 3,000,000-mile life for about twice the first cost of a bearing. This means that the average cost of reconditioning would be half the original cost of the bearing.

Unquestionably, bearings have been improved. Oil lubrication has shown very satisfying results and high-temperature grease has in many applications almost eliminated failures and permitted the use of bearings which are sealed to prevent application of grease between shopping periods.

It will probably never be possible for all railroads to employ exactly the same bearing practice, but it is becoming increasingly evident that average bearing life as well as miles per bearing failure are being greatly increased. It is another indication that there are still many opportunities for decreasing cost of Diesel-electric locomotive operation. It has been feared by many that Diesel maintenance costs would rise greatly with increasing age of locomotives—in fact, some hoped they would—but persistent effort on the part of manufacturers and operators is bringing specific items down and there seem to be many opportunities for still further reducing such costs.

Should Specialists Govern or Advise?

Modern terminal facilities still lag far behind the Diesel-electric locomotive production available to American railroads. Modern tools and labor saving devices are finding their way into Diesel shops and are proving their worth to such an extent that five mechanics well supplied with proper tools can replace six inadequately supplied mechanics who waste the equivalent of one mechanic's time searching for the tools to complete an assignment.

Manufacturers' recommendations, together with the experience peculiar to each railroad, suggest that periodic inspection and scheduled maintenance be followed closely in order to obtain the maximum service inherent in the Diesel locomotive.

Maintenance facilities being of major importance, have the railroads neglected to take into consideration the importance of a mechanical organization having the right to function with a minimum of restrictions? Is the departmental organization as modern as the equipment and facilities it is charged with using? Might it not pay to make up an impartial analysis, eliminating personal prejudice, to see whether an organization has been provided which is free to function in the best interests of the railroad?

Organizations tend to be perpetuated, sometimes in inadequate form, by following the lines of least resistance. Do not existing methods sometimes restrict the thinking, development and actions of present-day supervision, which, if permitted to assume a full measure of responsibility, would create an inter-

est on the part of supervisors in their future work.

Take, for example, the postion of a master mechanic. Theoretically, he is the chief mechanical officer of a division, but practically, in many cases, he is permitted to function only as a mechanical robot, directed almost entirely by people who have no functional responsibility, but who are recognized as specialists. In many cases, the "specialty" seems to consist mainly in antagonizing the local supervision. If a master mechanic is not capable, he should be replaced by a man who is. But specialized positions, such as Diesel supervisor, tool supervisor, welding supervisor, air brake supervisor, chief boiler inspector, are established, with their work in most cases, being often a duplication of that of the local supervision. This work could be carried out by an individual supervisor if the policy were made clear and the responsibility placed entirely upon him. Isn't it true that the man who is to perform an operation is in the best position to know the tools he requires and the method to follow, not to mention the satisfaction from his superior's recognition.

It is not surprising that the railroads are unable to attract the right men as supervisors when they watch from the sidelines as mechanics and see the way in which their supervisors are restricted in making decisions that would be of real benefit to the railroad, not to mention the manner in which unsatisfactory conditions are allowed to continue until such time as a decision is handed down.

NEW BOOKS

STEAM TURBINES AND THEIR CYCLES. *By J. Kenneth Salisbury, division engineer, Thermal Power Systems Division, General Electric Company. Published by John Wiley & Sons, 440 Fourth avenue, New York 16. 645 pages, 6 in. by 9½ in., cloth bound. Price, $9.*

The essentials of design of steam turbines are presented in this book in terms devoid of unnecessary abstract theory for users and manufacturers of steam turbines, designers of power-plant cycles and turbines, and test engineers in power plants. Thermodynamics, cycle theory, and flow of fluids background is discussed early in the book, with practical short-cut data for daily design work. In the Appendix are data on steam, theoretical heat rates, and steam charts. Illustrations and practical problems are found at the end of each chapter. Part I discusses the Fundamentals of Turbine Design; Part 2, The Regenerative Cycle; Part 3, Cycle Analysis, and Part 4, Application Engineering.

POCKET ENCYCLOPEDIA OF ATOMIC ENERGY. *By Frank Gaynor. Published by the Philosophical Library, 11 East Fortieth street, New York 16. 204 pages, 6 in. by 8½ in., cloth bound. Price, $7.50.*

This encyclopedia presents a comprehensive collection of brief definitions and explanations of the terms in the field of nuclear physics and atomic energy. It is intended merely to give a general understanding of the atom—its nucleus, its energy, and their relationship to human life and progress. Individual entries for every element indicate chemical symbol, group of the periodic table, name of discoverer, date of discovery, atomic number and weight, melting and boiling points, specific gravity, stable isotopes, radioisotopes. Entries for every member of the known radioactive facilities indicate symbol, atomic and mass numbers, parent and daughter isotopes, type of radiation and half life. Brief and concise descriptions are given of such subjects as nuclear fission, tracer technique, atomic bombs, the "H-bomb," etc. Electrical, magnetic, chemical and physical units; important nuclear research laboratories, power plants, installations, etc., are also described. Thumbnail biographical sketches of outstanding nuclear physicists and chemists are included, also a listing of the German equivalents for many of the terms defined.

RECOMMENDED PRACTICES FOR RESISTANCE WELDING. *By American Welding Society's Resistance Welding Committee. Published by American Welding Society, 33 West 39th street, New York 18, N. Y. Price $1.00. 58 pages.*

This new edition represents a modification and expansion of the standards originally issued in tentative form in 1946. Included are welding schedules for spot and seam welding mild and medium carbon steels, low-alloy steels, stainless steels, nickel, Monel, Inconel and magnesium alloys. Recommended practices for projection welding cover low-carbon and stainless steels. Flash welding data is provided for low and medium forging strength steels.

The section on methods of testing resistance welds includes the new peel test and an expanded discussion of the control of resistance weld quality by statistical methods. Other methods of test for which the standard specimen, method of testing and evaluation of results are given include the tension-shear test, cross and U-tension tests, shear and drop impact tests, fatigue test and twist test. The standard pillow test for seam welds is also described.

CAR INSPECTION AND REPAIR

Squeezing Cross-Ridge Diagonal Bracers

Portable unit made from an air-equeeze riveter for holding crossridge diagonal braces in position for welding

A pneumatic squeeze riveter with a special jaw and filler pieces is used to squeeze and hold together cross-ridge diagonal braces for welding at the Despatch Shops, Inc., East Rochester, New York. The unit replaces manually operated cams for squeezing the braces together and improves both the efficiency and the safety of the operation.

The braces are formed in a conventional press but are not completely closed. They are brought to the area of the portable squeeze unit and squeezed together with it for continuous arc welding. The squeeze unit squeezes the unclosed edges together and holds them while the edges are tack welded to hold them for the final welding. The unit is then removed and the seam continuous welded.

The squeeze riveter was modified for this operation by forging a special jaw and welding to the jaw the filler pieces necessary to make the tool fit the job. The jaw is 1½ in. thick and 7 in. wide at the bottom. The 7-in. width at the bottom is used to give the necessary strength without increasing the thickness beyond 1½ in. The steel for both the jaw and the filler pieces was forged from old car axles.

Simplified Gantry For Side Stake Welding

A simplified traveling gantry has been built at the Despatch Shops, Inc., East Rochester, New York, for applying hopper car side stakes by the Unionmelt welding process. The gantry is equipped with two welding heads and has a variable speed control for welding at speeds up to 60 in. per min. When affixing side stakes it is normally operated to weld the $\frac{5}{16}$-in. material at a speed of 32 in. per min., welding both sides of the stake simultaneously at the 32-in. speed.

The twin heads are mounted on a 4-wheel dolly which is driven by a ⅓-hp. electric motor through reduction gearing. The track on which the dolly

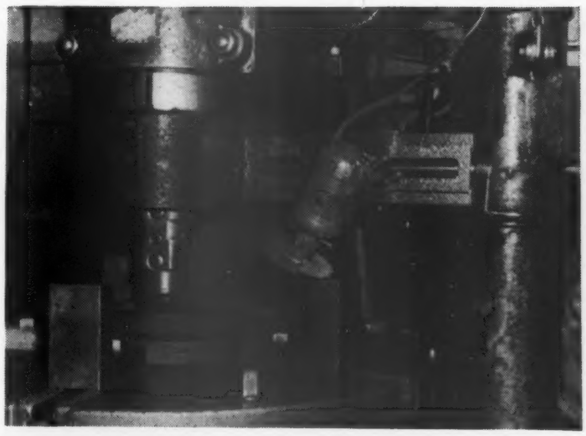
Simplified twin - head gantry for joining side stakes to side sheets by the Unionmelt welding process

moves is made from an angle 1¾ in. by 1¾ in. by 3/16 in. mounted on a 9-in. I-beam through angles 3 in. by 3 in. by ¼ in. spaced every 18 in. The welder is moved from one stake to another on two four-wheel dollies which run on tracks mounted on the jig that holds the side sheets for the side stake welding operation. Excess flux is removed by a vacuum cleaner for later re-use.

Grinding Chuck Jaws on Boring Mills

A device has been fabricated at the Beech Grove, Ind. car shops of the New York Central for grinding car wheel boring mill chuck jaws. The device consists essentially of a Cincinnati tool post grinder, Type S or SA, with a ¼-hp. motor, and a suitable mounting device. The chuck jaw grinder has three quick angular settings, 53 deg., 27 deg. and 2 deg. 52 min., the latter of which is the angular representation for a taper of 1 in. in 20.

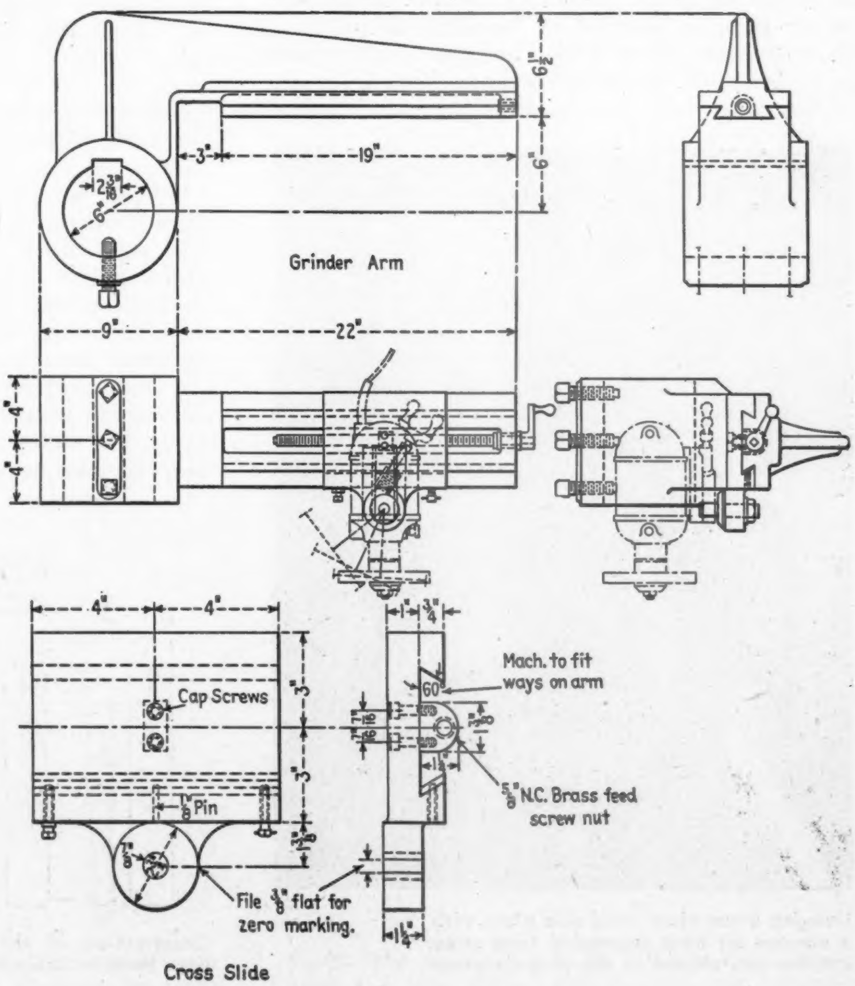
The first step in grinding each jaw is to set the grinder at a 53-deg. angle and grind the ⅝-in.-long bearing flat. The setting is then changed to 27 deg. and the 11/16-in.-long clearance flat is ground. The final setting is 2 deg. 52 min. to grind the final bottom portion of the jaw. In each step the machine is set at the correct position on its horizontal travel



Grinding device in position for grinding car-wheel boring-mill chuck jaws

range by a single handle crank. The feed at the required angle is by hand through a double handle crank mounted on the tool post grinder.

The principal parts of the chuck jaw grinding device are a grinder arm which is attached to the boring mill spindle by three hardened set screws ⅞ in. by 4 in. with National Coarse threads, a cross slide by which the tool post grinder is brought into position, a slide screw which moves the grinder horizontally, and an abrasive wheel 6 in. by 1½ in.



Construction details of a device for grinding car-wheel boring-mill chuck jaws

Crane Hook Aids Heavy Car Repairs

Raising a wood side plate to the scaffold level for hanging on the car with an air hoist

A simple but useful innovation in heavy freight car repair work is installed at Despatch Shops, Inc., East Rochester, New York. Lengths of strap iron 3 in. by 1/4 in. by 8 ft. are hung from the main transverse shop cross beams with the bottom edge of the iron about 3 ft. above the top of the car being repaired. A 1-in. hole is drilled near the bottom of the strap iron hanger to receive the hook of a 1-ton air hoist. The hoist, which weighs about 20 lb., can easily be hung by one man with one hand from the scaffolding which runs along a little below the level of the top of the car.

The hangers are used to suspend the small hoist during heavy car repairs for such jobs as removing and applying one-piece wooden side plates, steel side plates, doors and other items too heavy to be lifted by hand. Lift trucks are used with the hoists to raise the heavy parts up to the scaffold level.

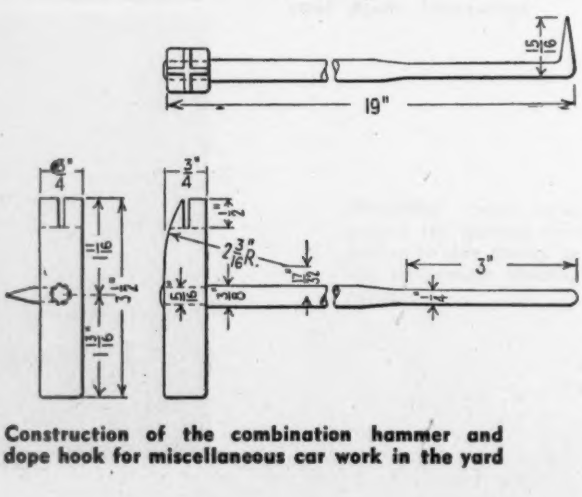
Hanging a one-piece wood side plate with a one-ton air hoist suspended from strap iron hangers affixed to the shop structure

Combination Hook and Hammer

A combination hammer and dope hook which can do a variety of miscellaneous yard jobs on freight cars was developed by car department personnel on the Nickel Plate. The hammer is made of high-grade tool steel to reduce dimensions so that the hook may be used in restricted quarters while still having the necessary strength for prying. The head is made of cold rolled steel.

The hammer and dope hook is 19 in. long. The diameter of the handle is 3/8 in., except for the last three inches on the hook end where it tapers to 1/4 in. The head is 3/4 in. square by 3 1/2 in. long. Two slots 3/32 in. by 1/2 in. are cut in the head at right angles to each other for use in pulling tacks. The handle is mounted on the head slightly above center for better balance, as shown in the illustration. All corners are rounded off with a 1/8 in. radius.

Among the jobs which the tool is designed to handle are raising and lowering journal box lids; hooking journals to detect rough journals, waste grabs, pulled linings, etc.; adjusting journal box packing; prying the brake beam head away from the wheel when applying brake shoes; and holding the brake beam head up while removing and applying brake hanger pins. The hammer portion is used for making temporary repairs, applying commodity cards, bad order cards, etc., and, the slots in the head are used to remove tacks which hold cards.



Construction of the combination hammer and dope hook for miscellaneous car work in the yard

Arc Welding in Railroad Car Shops*

Economies in construction can be effected by adapting to car design many ideas learned from welding experience

THE past decade has seen a rapid expansion of welding by the railroads precipitated by the wartime needs and the demands imposed by the large programs for replacement of rolling stock. The advent of the all-welded car, while not new to a small segment of the railroad industry, was a revolutionary change because of the tremendous scale with which it has been introduced.

Unfortunately, however, some of the welded car designs are simply riveted designs from which the rivets have been eliminated and welds substituted at the discretion of the shop. This is understandable because car programs were literally converted over night from riveted to welded construction in the face of ever-increasing orders and a shortage of skilled and experienced personnel. In spite of these difficulties many thousands of well-built cars have been produced, but the need for design changes on such short notice did not permit adequate studies to be made with the result that many of the advantages available from modern welding practice were not fully realized.

The importance of good design for welding cannot be overemphasized. Constant efforts must be directed toward utilizing the knowledge gained not only from building welded railroad equipment, but also from building ships and other welded structures. Designers must learn to provide the best designs and procedures for welding their products at the lowest possible cost. This requires the utmost cooperation between the engineering department and the shop.

An example of a design that is simply a transition from riveted construction is shown in the accompanying illustrations. This particular design is considered faulty not only from a technical point of view, but also from a production standpoint in that considerable difficulty was experienced in completing the job. Fig. 1 shows a section through the lower sill of a gondola car. This arrangement gave satisfactory results with rivets and was welded as shown by eliminating the rivets. The sides were fabricated and put into position without difficulty. However when the flanged floor plates were inserted the troubles began. Because of inaccuracies in the flanging operation, the floor plates had a poor fit up. The gaps in the floor plates tapered from a tight butt to openings of ⅝ to ¾ in. Considerable expense was involved in filling up these gaps so as to have a flush floor surface.

An improvement as shown in Fig. 2, eliminates the flanging operation, and the fillet weld at the floor plate is easier to make than on the flanged edge where poor fit-up gave trouble. A saving in welding and in weight can be made as the improvement eliminates the weld at the bottom edge of the side sheet and the double thickness of metal, side sheet and floor flange. In addition the fit up of the floor plates can be improved because the plates can be sheared to size with greater accuracy. Some corrosion difficulties

* Abstract of a paper presented at a meeting of the American Welding Society by E. Di Liberti of the Air Reduction Sales Company.

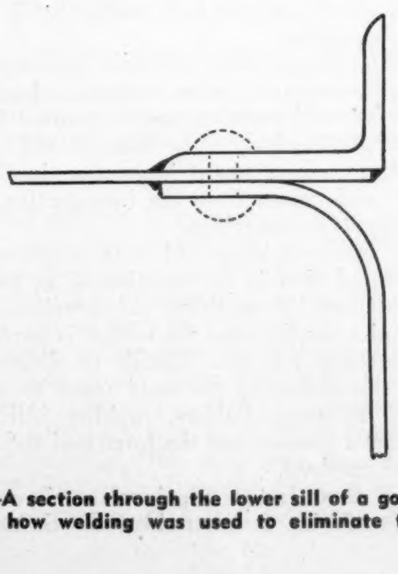


Fig. 1—A section through the lower sill of a gondola car showing how welding was used to eliminate the rivets

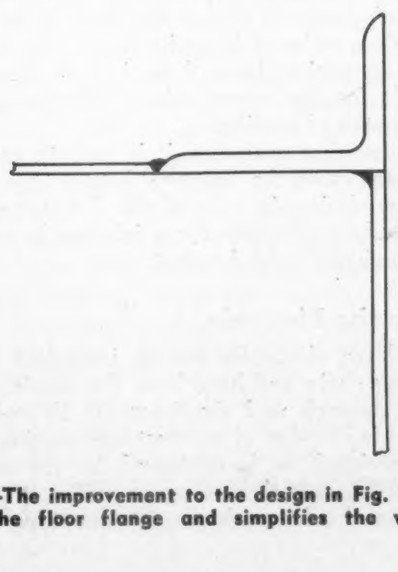


Fig. 2—The improvement to the design in Fig. 1 eliminates the floor flange and simplifies the welding

can be decreased because the open space or pocket between the flange of the floor sheet and the side sheet is eliminated.

Examples of Better Methods

A competent designer has offered the following suggestion to decrease weight and save cost. The customary stiffener for side sheets is a modification of that used with rivets, as shown in Fig. 3. Some weight saving has been realized by eliminating the rivets and shortening the toe of the flange. By using a rolled Tee section as shown, greater stiffness can be achieved, a hot pressing operation eliminated and the stiffener can be attached with less clamping than the hot section.

Fig. 4 shows how cracking troubles can be avoided by careful design. Originally, in welding the center plate to the bolster, difficulties were experienced with the welds cracking through.

By increasing the width of the bolster to permit the weld to be made to the flat surface, cracking can be avoided. On a production job of this type the weld must be made with a large-diameter electrode in a single pass. With the original design the weld could not be made to penetrate to the root. This trouble is eliminated in the modified design.

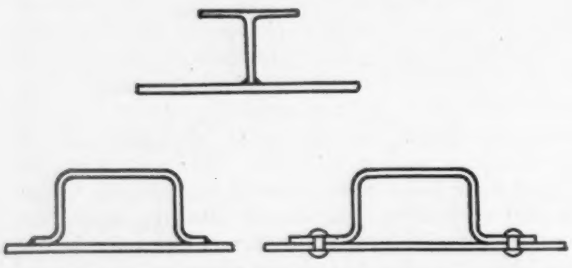


Fig. 3—Three possible designs of a side sheet stiffener

A related example to show further the effect of sharp corners and the inherent cracking troubles encountered is shown in Fig. 5.

A large number of cars were cracking the center sill from the draft gear pocket between the rivets. Examination showed that the center sills had been cut very carelessly with a hand torch so that instead of having a nice smooth radius, the ends of the pocket were simply a series of jagged corners. The resultant stress concentration from these jagged edges were responsible for the center sills cracking after only several months of service.

From these few examples, it is easy to recognize that, in many cases, the difference between a poor and satisfactory design is only slight. Yet these slight differences determine whether a job can be properly and economically welded or not.

Choosing the Electrode

Arc welding electrodes are an important link in the welding chain and have been the object of considerable research and development. To some the importance and value of an electrode coating is not fully appreciated, as is evidenced by the common question, "Why are there so many different types of electrodes and why can't we use one type for all work?" Of course, the predominant source of this question is storekeepers and purchasing departments. However, the same thought is also in the minds of many men directly connected with the welding industry. It is easy to appreciate that the array of electrodes offered today can be confusing to many confronted with the task of selecting an electrode for each job. But it must be remembered that arc welding has grown out of its short pants and the old dilemma as to whether a weld was going to be strong enough to hold the pieces together has been supplanted by very specific requirements for mechanical properties and operating characteristics. The "growing up" process has introduced many complex requirements that can only be met by the large number of specialized electrodes designed for these requirements. As long as there are so many different kinds of jobs to be done there is little hope for the perfect all-purpose electrode that can do all the different jobs satisfactorily.

The railroads have accomplished a great deal with the relatively few types of electrodes normally carried as stock items, the E6010 and E6012. However more of the newer specialized types can be found in railroad storerooms now.

Functions of the Electrode

The covering is expected to control the mechanical and chemical properties of the deposited weld metal. But even though the chemical composition largely determines the mechanical properties, the amount of impurities such as slag and oxides can seriously influence the mechanical properties. For that reason a covering should provide weld metal that is free of injurious impurities.

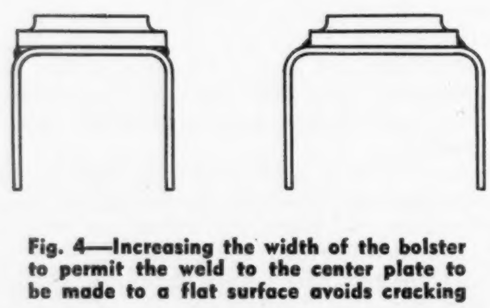


Fig. 4—Increasing the width of the bolster to permit the weld to the center plate to be made to a flat surface avoids cracking

In addition to providing adequate coverage of the molten weld metal so as to control porosity, the nature of the weld metal protection should be such that cracking difficulties in the heat-affected zone are eliminated. This is a recent innovation in the electrode field and comes from the introduction of the low-hydrogen-type coverings.

The last and most important factor from an application point of view is the function of an electrode covering to control the usability characteristics. These characteristics are the ones the welder is particularly concerned about but are difficult to define. Such things as the ability of the weld metal to wet the surface of the plate, fluidity, rapidity with which the weld metal freezes, and the force and stability of the arc are involved.

While all these factors are involved, it would be extremely confusing to select electrodes on the basis

of these factors. For that reason the American Welding Society has concentrated considerable attention on electrode specifications which have succeeded in eliminating much of the confusion that would exist without these specifications and classifications.

In spite of the simplification that has resulted, there is occasional confusion presented by the wide variety of electrodes, particularly when two or more types seem to do the same job. This can be clarified by a proper understanding as to why several types of electrodes seem to perform well on the same application. The following example, while it involves a locomotive application, is typical also of the car shop situation.

Electrode Choice by Characteristics

A large railroad uses different electrodes to patch fireboxes in each of its major shops. The repairs are made in the usual manner with the portion of sheet to be replaced cut out with an oxyacetylene torch. The cuts are made between the rows of staybolts and the fireside edges of the fitted patch and existing sheet are beveled to form an included angle of 60 deg. Efforts are made to maintain a $\frac{1}{16}$ in. root opening. One shop uses E6010 electrodes for welding these patches whereas another shop on the same railroad uses E6012. Each shop is doing a satisfactory job and the reasons for preferring the specific type of electrode are readily understandable. The shop using the E6010 type electrodes has skilled boilermakers that can fit patches within close limits so that welding with the No. E6010 electrodes can be done readily.

The second shop, while of large size, is in a remote area and apparently suffers from a shortage of personnel with the degree of skill available in the main shop. This lack of skill manifests itself in the form of poorly fitted patches with root openings that vary considerably. Furthermore, the skill of the welders

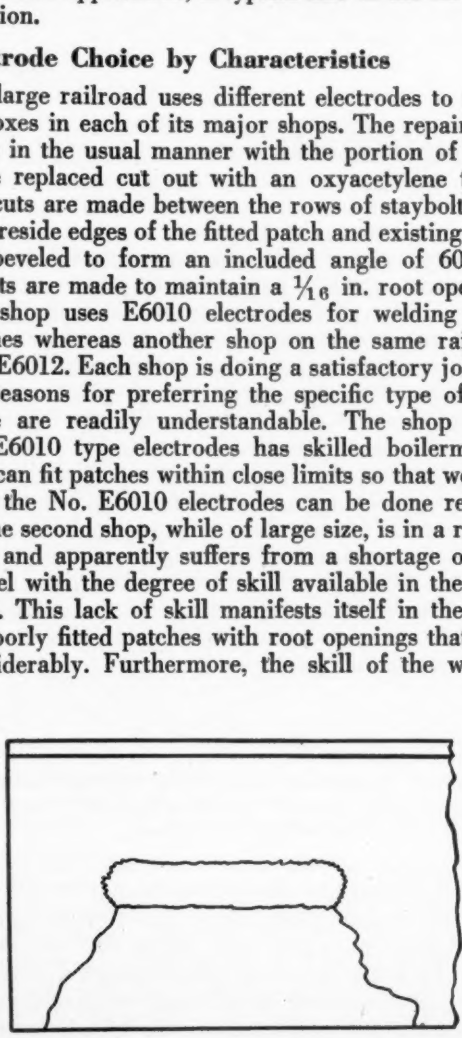


Fig. 5—Careless cutting of the center sill with jagged corners causes stress concentration that cracks the sill in a short time

is such that difficulty is experienced with the harsher arc and more fluid weld metal of the E6010 electrodes, but they succeed in obtaining a workmanlike job with E6012's, which have easy handling properties especially on poor fit up work.

By selecting the electrode on the basis of operating characteristics alone, many difficulties which stem from factors unrelated to electrode selection can be overcome with each type of electrode seems to perform satisfactorily. The shop with the less skilled personnel learned to overcome their difficulties by selecting electrodes on a trial and error basis, but the general situation would probably not exist if the railroad had unified welding supervision. Unfortunately the railroad management hasn't recognized the importance of good welding supervision and, as a result, welding has been relegated to the rank of a part time job for supervision by other trades. Centralized supervision would assure more uniform practices in the widely dispersed shops of a railroad and has the advantage of resulting in better work because the responsibility for welding is in the hands of welding personnel. This would also assure that operators would be properly trained and qualified to perform the type of work required regardless of the type of electrode specified.

The type of electrode that should be used on firebox work has been the subject of much discussion, but as shown by this railroad, both the E6010 and the E6012 electrodes can be used with satisfactory results. A discussion of the characteristics of the two types of electrodes may be of sufficient value to be worth including here.

Qualities of Two Electrodes

As is known, the E6010 type provides high quality weld metal deposits which in general are superior to the E6012 type. However, the greater difficulty of application because of the harsher arc and more fluid weld metal, together with the lower current handling capacity as compared with E6012, tend to make the E6012 the more desirable from a production point of view. While the E6012 electrodes are reputed as having poorer quality of weld metal, recent advancements in this type of electrode show that clean deposits with mechanical properties that exceed those of the E6010 will certainly make the E6012 a still more favored type. These developments together with efforts to provide electrodes of the EXX12 type that match the low-alloy, high-strength steels will permit better and lighter designs of cars.

The introduction of low-hydrogen-type electrodes has created widespread application in railroad shops. Without venturing into the reasons why superior weld metal deposits are obtained where the hydrogen content of the arc atmosphere is reduced, we know that if a job has been properly welded with low hydrogen electrodes, the resultant weldment is the best that can be obtained at the present time. This is in addition to the many other advantages such as the ability to weld steels of higher hardenability than ordinary mild steels and steels of the free-machining high sulfur type. One of the earliest applications of low hydrogen electrodes was to replace stainless types for welding high carbon wear plates to car trucks. As is customary with any new item, venturesome welders tried the low hydrogen electrodes on many other applications. One of the most successful of these trial and error applications is the welding of broken locomotive frames with low-hydrogen electrodes. While some may question the need for low-hydrogen electrodes for locomotive frames, the higher strength, ductility and shock resistance have been proven on at least one railroad by giving better service results.

These new inert, gas-shielded arc welding processes are becoming absolute necessities for the construction and repair of many stainless, aluminum and non-ferrous components as used in late model passenger and dining cars.

QUESTIONS AND ANSWERS

The question and answer department is included for the benefit of those who may desire assistance on problems involving matters pertaining to the operation or maintenance of air brakes, Diesel-electric locomotives, steam locomotive boilers or steam locomotive practice. Any inquiry should bear the name and address of the writer, whose identity will not be disclosed unless special permission is given to do so. Anonymous communications will not be considered. Inquiries addressed to this publication will be referred to the source from which authoritative answer can be secured.

Diesel-Electric Locomotives

Q.—What are the advantages or disadvantages in reversing the flow of the inner coil on a CFK steam generator?

A.—The CB boiler would superheat, and then it would deliver wet steam, and it was difficult to regulate. The flow of water had been reversed and there was considerable residual heat in the large refractory used in this generator which would throw the steam into superheat. During the war one of the Southern roads had a coil on the 4225 generator that ran several times as long as the other coils had. When it was removed, it was learned that the inlet and outlet were reversed. When the capacity of this generator was increased, the road reversed one of the stepped up coils, and liked the operation so well that all similar installations were charged in this manner.

Q.—What operating condition will indicate a ruptured coil in the heat exchanger? Will cold water go into the hot water line or vice versa?

A.—The heat exchanger is a vessel with a coil inside through which the water from the steam separator returns at zero to 40-lb. pressure. The water pressure on the outside varies from 200 to 350 lb. and therefore tends to go inside the coil. As the discharge from the coil leads back to the water storage tank, the water which should go into the steam generator enters the heat exchanger coil hole and returns to the storage tank. This water has already passed through the controls which meter the fuel according to the amount of water flowing, and a quantity of fuel sufficient to take care of this volume of water is fed to the burner. As the volume of water passing through the control exceeds the amount being evaporated, superheat results. On some models of generators, water flow indicators are incorporated to aid in detecting this condition. The remedy is to jump the coil out, shut off the return to the water storage tank and the return water at the separator, and bleed the separator to discharge the water on the ground until the coil can be replaced.

Q.—What is the purpose of the economizer coil?

A.—Down towards the bottom of the first few layers of the outer coils there's a certain amount of external corrosion due to the moisture and gases of combustion combining to form corrosive gases and acids. On the inside of some of the coils there is pitting due to an acid condition in the water. Sometimes you get a direct erosion from sand in the water. The economizer coil is one which can be replaced cheaply instead of replacing the outer coil because of failure due to erosion or corrosion. After the water leaves the heat exchanger it goes through this coil and if it has any free oxygen, the oxygen will attack that coil before it gets to the main coils, or the moisture in the gases of combustion and the acids in the gases of combustion will attack that coil before it will attack the others. Consequently, the coil can be replaced cheaply. It also increases efficiency by 10 to 15 per cent by taking the heat from the stack gases to heat the water. On some of the generators we have reduced the stack gas temperature from approximately 850 deg. down to 650 deg.

Q.—Will operating the Servo Control manually accomplish any benefits if the steam generator fails to fire? Will any ill effects result?

A.—I presume that is meant to start the generator off by retarding the up movement of the bow tie on the Servo Control until such time as ignition has taken place. The same thing can be accomplished by using the water by-pass valve. I don't see any absolute danger in it, and some maintainers practice that, but it should be done with the manual water by-pass valve. The big thing would be to get at the ignition failure and have it corrected so that the ignition takes place rather than holding the Servo Control back. The thing to do is to correct the primary cause.

Q.—Do you advocate soot remover compounds?

A.—About a month ago one road burned up two fire pots. When the side plates were pulled off, soot removing compound came rolling out. The entire thing was clogged solid with soot removing compound. Most are sodium chlorides or chlorates which evaporate or dissolve at a temperature of between 1,100 and 1,400 deg., and if they don't pass through the fire, they stay in their original state, passing into the flue spaces and clogging up those flue spaces. Then you start adjusting the boiler to get more steam

* These questions and answers were submitted following a talk at the December meeting of the Chicago Railroad Diesel Club by M. Sudheimer of Electro-Motive.

out of it. The only thing that can be adjusted is the amount of fuel, not the water because we don't have an adjustment on the pump. The chain of events that follow because a steam generator is clogged up with soot removing compound can lead into most anything. Thus the use of soot removing compounds of the sodium chlorate or chloride type is not advocated. Soot removing should be done as a terminal job once a month or oftener if conditions of operation make it necessary

Q.—Can a section of coil be jumped out or jumped across in an emergency?

A.—The only coil that you can't jump out satisfactorily would be the inner coil; because you'll have a mass of molten metal down in the bottom of the refractory.

Steam Locomotive Practice

By George M. Davies

Use of Aluminum Alloys

Q.—We would appreciate any information in connection with aluminum-alloy plates and shapes. Which alloys should be used for cabs, runboards, etc. which are to be fabricated by welding? Should gas or arc welding be used?—F.E.B.

A.—The most weldable aluminum alloy is Alcoa 3 S (aluminum and manganese). This alloy has higher mechanical properties than commercially pure aluminum but has very similar welding characteristics. The Alcoa 3 S alloy is the standard material where the strength of welded parts made from this alloy is suitable, its use is suggested in preference to any other material.

Where it is desirable to use a material of higher tensile strength an alloy such as Alcoa 52 S is suggested for welded applications. This material has a strength about twice that of Alcoa 3 S but is more difficult to join by fusion welding.

In another group of alloys, the strength depends on heat-treated operations subsequent to welding. The weldable materials in this group include the aluminum-magnesium, silicon alloys (Alcoa 53 S and Alcoa 61 S).

The 3 S and 52 S alloys are used for cab and runboard plates, while the 53 S and 61 S alloys are used for bars and shapes.

Both gas welding and metal-arc welding are used for fabricating cabs and runboards. A recent development in the field of arc welding aluminum is the Tungsten-Arc welding process which involves the use of a metal arc, a tungsten electrode and an inert gas envelope.

The mechanical properties and the soundness of welds made with the tungsten arc are exceptionally good. No welding flux is used: consequently no cleaning operations are required subsequent to welding and no flux contamination can occur. The tungsten arc is the only method that is suitable for making fillet and butt welds in the overhead position and position welds in a vertical plane can be made more easily and uniformly by this method than by any other welding method.

Front End Netting

Q.—Does the I. C. C. Bureau of Locomotive Inspection have rules and regulations governing the operation of steam locomotives through forest reserves?—R. E. A.

A.—The I. C. C. Bureau of locomotive Inspection, "Laws, Rules and Instructions for Inspection and Testing of Steam Locomotives and Tenders and other than Steam Locomotives", do not cover any special requirements for locomotives operating in Forest Reserves. As a general rule the various states have their own laws as to the operation of steam locomotives through forest reserves, a typical example of which is the New York State Law.:

Sec. 72, Chapter 130, Laws Of 1908:

Where railroads run through forest lands in counties containing part of the forest preserves, they shall provide locomotives thereon with netting of steel or iron so constructed as to give the best practicable protection against the escape of fire and sparks from the smoke stacks thereof and adequate devices to prevent the escape of fire from ashpans and furnaces which shall be used on such locomotives.

Chapter 494, Order 4-1-1909:

Requires oil burning locomotives to be used in the forest preserve lands from 8 A.M. to 8 P.M. from April 15 to November 1 of each year, also that no coal burning locomotive shall be operated unless inspected by the Public Service commission and certificate removable at pleasure, be issued permitting use within forest preserve.

Screw Threads

Q.—I would appreciate information in connection with screw threads. Are the National form threads the same as the United States Standard Threads?—B.F.L.

A.—The form of thread profile of the American National Screw thread was previously known as the United States Standard or Sellers Profile.

The adoption of the National form threads did not present any new standards as to the form of the thread but extended existing standards by specifying limiting dimensions for threads in common use. Two thread series were adapted, a coarse-thread and a fine-thread series. The coarse thread series is recommended for general engineering work and where rapid and easy assembly is desired; the fine thread series is recommended for automotive and airplane use and wherever minimum weight is desired.

The coarse thread series is the former "United States Standard" supplemented in the sizes below ¼-in. by a part of the "Standard Proportions for Machine Screws" established by the American Society of Mechanical Engineers. The fine thread series ¼-inch to 1½-inch, inclusive, is in accordance with the former Regular Screw-Thread Series established by the Society of Automotive Engineers. This is supplemented below ¼-in. by sizes selected from the above-mentioned standard established by the American Society of Mechanical Engineers.

Schedule 24RL Air Brakes

Dynamic Interlock Control Portion

961-Q.—What does seating of lower valve 3 accomplish? A.—Lower valve *3* seated will hold any automatic or electro-pneumatic straight air application off.

962-Q.—Describe the operation of an independent application if desired while the dynamic brake is on. A.—Air from the independent brake valve will flow through pipe and passage *20*, move double check valve *252*b to its lower seat, connecting passage *20* and passage *16* to the relay valve to apply the air brake.

963-Q.—How is the independent release accomplished? A.—By the reverse flow of air through passages *16*, *20*a, pipe *20* and independent brake valve to the atmosphere.

964-Q.—What happens when an emergency application is made? A.—A pneumatic switch controlled from No. *15* pipe of D-*24* control valve is opened.

965-Q.—What will result from opening of the pneumatic switch? A.—The control circuits are de-energized, which nullifies the dynamic brake and de-energizes the *FA-4* dynamic interlock magnet valve. The air will then operate in the normal manner.

966-Q.—Is the circuit to the dynamic interlock magnet opened for a train over speed or safety control brake application? A.—Yes. The No. *25* pipe connects to a pneumatic switch which will open the circuit to the FA-4 dynamic interlock magnet.

967-Q.—How does nullification of the dynamic brake differ on locomotives built by Electromotive Co.? A.—Only the No. *12* pipe controls a pneumatic switch, therefore the dynamic brake is nullified only from a brake valve initiated emergency.

Break In Two-Protection Feature

968-Q.—How does the Break In Two-Protection Feature Function? A.—It provides protection against loss of main reservoir air, and possible release of brakes, from an emergency application initiated from the train when the brake valve handle remains in charging position.

969-Q.—What functions to initiate this protection? A.—A double check valve between the No. *12* line from the H-5A Relayair valve (used for sanding), and the No. *1* line from the FA-4 magnet valve (used for overspeed control).

970-Q.—How does the double check valve function? A.—The double check valve allows air from the sanding volume reservoir to connect to chamber *E* of the overspeed application valve, when an emergency application is made from the train, caused by a break in two, conductor's valve, etc.

971-Q.—Describe the operation when air connects to chamber E, of the overspeed application valve. A.—Diaphragm *10* will move downward, open valve *15* and vent the No. *10* line through pipe *10*, passage *10*, cut-off valve, passage *3*, overspeed suppression valve, passage *7*, overspeed application valve through open valve *15* to passage *6* and atmosphere, moving the service or emergency application piston to its application position.

972-Q.—How is loss of main reservoir air to the atmosphere through the open brake pipe prevented when a service application portion is used? A.—Air supply to the brake pipe will be cut off by cut-off valve *151* in the brake valve, which is controlled by the service application slide valve.

973-Q.—How is loss of main reservoir air prevented when the emergency application is used? A.—Air supply to the brake pipe is cut off by emergency piston *161* when it moves to application position.

974-Q.—What provides the proper blow down time for the sanding volume reservoir air? A.—A Tee fitting with a choke.

975-Q.—What feature is provided to prevent a brake application during a manual sanding operation? A.—A double check valve between line No. *9* and *12* and the brake valve, is used for this purpose.

976-Q.—What valve is recommended if the break-in-two protection feature is used with the emergency application portion? A.—The application insuring relayair valve.

977-Q.—What actuates the application insuring relay air valve? A.—Air pressure developed in pipe *15* from D-*24* Control Valve in emergency position.

Steam Locomotive Boilers

By George M. Davies

Does Shape Determine Strength?

Q.—Does the shape of a firebox crown sheet, butt-welded, patch in any way determine its strength, such as the rectangular, diamond or saw-tooth shape patch?—E.K.L.

A.—The shape of a crown sheet patch is of little importance from a standpoint of strength, as the strength of the structure is not dependent upon the strength of the patch. The crown sheet is supported by the staybolts and the load on the patch is carried by the staybolts.

The shape of the patch should be as uniform as possible and large enough to replace the damaged portion of the sheet. It is not necessary that any uniform shape be adopted, the shape of the patch being governed by the area that is damaged and requires renewing. The joint between the patch and the crown sheet should be spaced evenly between the two rows of staybolts.

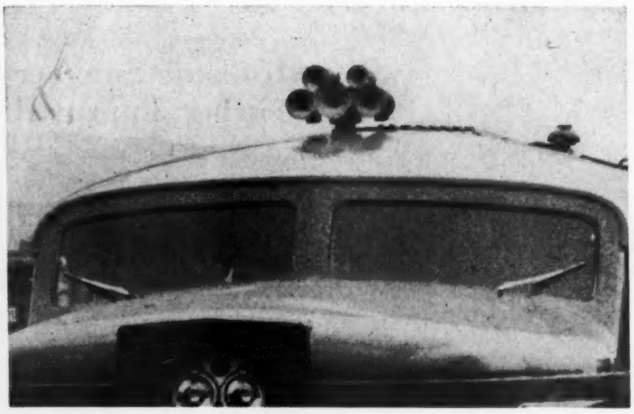
Welding Stays On Fire Side

Q.—Is there an I. C. C. Rule that permits the seal-welding of staybolts on the fire side of the firebox sheets of a locomotive boiler?—M.E.F.

A.—I do not know of any I.C.C. rule that permits the seal-welding of staybolts on the fire side of the firebox sheets of a locomotive boiler.

In 1946 permission was granted by the I.C.C. to seal-weld staybolts in fireboxes for test purposes in that no objections would be made (for experimental purposes) to the use of the staybolt applied in the usual manner with seal welding around the edge of the staybolts on the fireside, with the understanding that no welding would be applied to the staybolts in an endeavor to repair leaking or otherwise defective bolts.

Nathan Develops Airchime Whistle



A five-tone Airchime mounted on a Diesel Locomotive cab

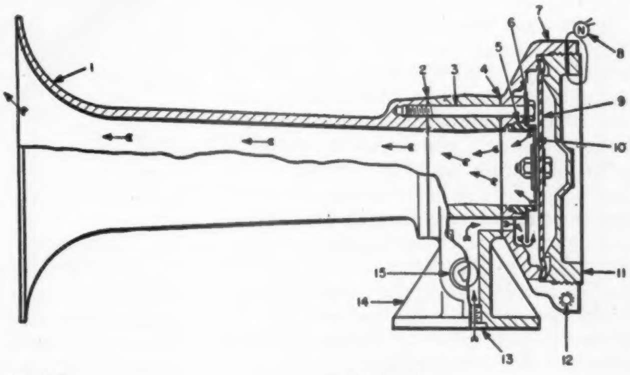
The Nathan Airchime whistle is basically a musical instrument, each horn of which emits a single tone ot predetermined pitch or frequency. The tone is produced by a circular diaphragm, or reed, which is vibrated by compressed air to propagate sound waves, the pitch or frequency of the tone being determined by the size of the bell and the natural period of vibration of the diaphragm.

To obtain the flute-like tone quality of the steam whistle the contour of the inside of the resonator or bell follows a specially designed contour which controls resonances only to the fundamental frequency of the vibrating diaphragm and the first two octave overtones. All parts of the whistle structure must be sufficiently heavy and rigidly constructed to prevent the introduction of metallic harmonics with consequent change in tone quality.

The Nathan Airchime whistle is built in various combinations of bells to produce single- or multiple-tone whistles. The body is composed principally of four major parts or assemblies: the bell (1), base (14), diaphragm-head assembly (7), and the diaphragm assembly (9). The base provides a mounting flange for the entire whistle assembly and serves essentially as a manifold for the various bells and diaphragm-head assemblies.

The bell and diaphragm head are secured to opposite faces of the base by three bolts (3) which also hold the diffuser ring (6) in place. The ring in turn secures the circular clapper seat (5) in a recess in the diaphragm head (7). To prevent leakage of air, gaskets (2) and (4) separate the bell and the diaphragm-head assemblies from the base. The diaphragm assembly, composed of phosphor-bronze diaphragm discs (9), a clapper disc (10), and spacers, is secured in the diaphragm head by the adjusting cap (11). This cap screws into the diaphragm head, tightening the diaphragm against a circular land in the diaphragm head. After positioning the adjusting cap to maintain proper tension on the diaphragm, the clamp screw (12) through the split bracket at the bottom of the diaphragm head is tightened, locking the adjusting cap in position. Finally, to prevent change of adjustment, the diaphragm head and adjusting cap are drilled, lockwired, and sealed.

An air-inlet port in the bottom of the mounting flange as well as two alternate ports on opposite sides of the stanchion above the mounting flange provide connections for the air-supply line. The whistle is sounded by admission of air through a valve in the air-supply line. The intensity of the signal can be modulated for terminal or suburban service. The whistle produces its full intensity of sound at an air pressure of 100 lb. per sq. in., at which pressure it is said to have a decibel rating equivalent to, or greater than, a similar steam chime whistle



1—Bell
2—Gasket
3—Bolt
4—Gasket
5—Clapper Seat
6—Diffuser Ring
7—Diaphragm Head
8—Seal
9—Diaphragh
10—Clapper Disc
11—Adjusting Cap
12—Clamp Screw
13—Air Inlet Port
14—Base
15—Alternate Air Inlet Port

Section of a single horn of the Nathan Airchime whistle

operated on 200 lb. per sq. in. of steam pressure, and a coverage to the rear usually greater than that of steam whistles.

For modulated tone, the minimum air pressure at the base of the whistle while blowing is 20 lb. per sq. in. A double-stem whistle valve provides a means in a single unit for selecting either loud or modulated tones.

The Airchime is a development based on a study made by the British Columbia Government through its chief inspector of railways, Robert E. Swanson, because of complaints at the lack of distinction between the horns of Diesel locomotives, steamship whistles and the horns on highway vehicles. The whistles are produced by the Nathan Manufacturing Company, 476 East One Hundred Sixth street, New York 29, in single-tone, three-tone, and five-tone combinations.

Chime-Tone Air Horn

This horn is of cast aluminum construction, providing lightness and strength. It uses a plastic diaphragm, unaffected by oil, moisture, cold weather, ice or snow. The diaphragms are made in one piece and ow only two sizes, thus simplifying maintenance and reducing the need for extensive parts inventories.

Known as the Chime Tone, this horn, manufactured by the Leslie Co., Lyndhurst, N. J., comes with 2, 3, 4 or 5 notes, which blend to give a musical chord.

A choice of chords, all fully harmonious, give an arresting tone and audibility, and provide high decibel output with low air consumption. Modulated blasts can be used for going through towns by use of a two-lever operating valve which is available.

The mounting for the new horn is interchangeable with the mounting of present Leslie air horns, thus making replacement a simple matter. Railroads desiring different signals or distinctive pitches can use the device in conjunction with present equipment as the mounting base fits the same mounting pads as single air horns made by the manufacturer.

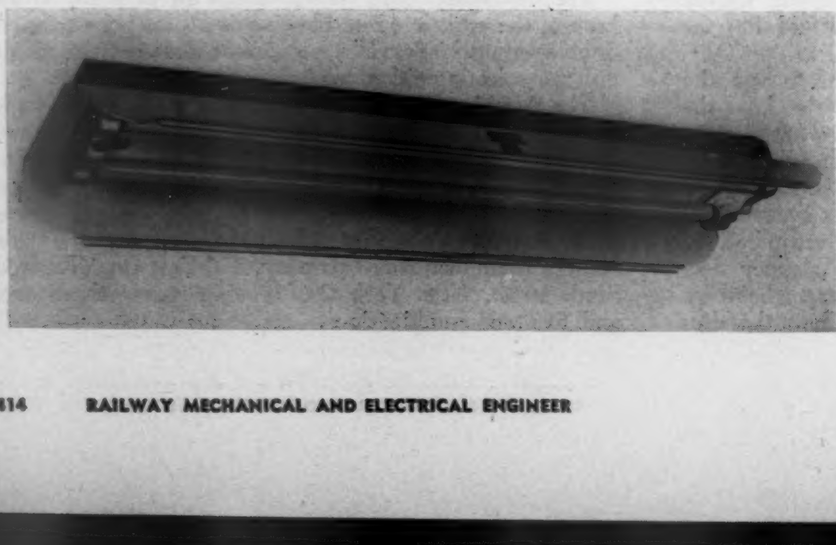
Industrial Fluorescent Luminaries

New two- and three-lamp industrial fluorescent luminaires with 2½ and 5-in. lamp spacing heavy-duty lampholders are available from the Westinghouse Electric Corporation. These units represent a change to the heavy-duty lampholder in the standard three-lamp unit, and the addition of a new line of two-lamp units with 5-in. lamp spacing heavy-duty lampholders.

Starters are mounted in the lampholders, indexed to associated lamps, and accessible from within the reflector without removing the lamps.

The units are available with open-end and closed-end porcelain enamel reflectors, both bearing the RLM label of approval. The complete luminaire consists basically of a steel hood assembly with lampholders, ballast, and a one-piece steel reflector.

The hood assembly is formed from heavy gauge steel, and ballast and lampholders are wired as part of this assembly. Two spring-loaded wing locks hold the reflector to the hood and make installation easy. The reflectors are made of heavy gauge porcelain enameled steel with an average reflection factor of over 82 per cent. The shielding angle is approximately 13 deg.



Small Size, Insulated Electrode Holder

The type LJ-1 holder combines the advantages of tong and hold type holders in providing a strong grip which is easy to release with thumb pressure. Its small size makes it useful for operation with heavy gloves in corners and other confined areas.

The tip of the jaw end of the device, made by The Lincoln Electric Co., Cleveland 1, Ohio, is covered with a high temperature resistant, asbestos base compound which is highly flexible. It is said to resist the abrasion of rubbing against metal as well as the wear caused by weld spatter.

Due to its flexibility, the molded tip can be formed to cover the end of the holder completely, thus giving full insulation. The electrode is held close to the end of this tip so that the holder can be worked in close quarters without the danger of grounding.

A lever type jaw is used for gripping the electrode. The jaw is loaded with 50 per cent additional spring capacity which gives approximately nine times as much grip as coil springs. The release handle lever, however, gives a high degree of leverage so that inserting or releasing an electrode is easy. Cam jaw construction, open to one side of the holder, gives one position, 20 deg. off vertical for downhand welding and a second position, 30 deg. off horizontal for overhead welding.

These electrodes are manufactured in the 250 ampere size for $\frac{1}{16}$ to $\frac{3}{16}$ in. electrodes.

Holland Snubber Spring Improved

Further refinements in design of the volute snubber spring, made by the Holland Company, Chicago, constitute the most recent in a series of continuous improvements since the original Holland Style A volute snubber springs was first offered in 1934.

In the latest Style A-7-A, a new and revolutionary method of manufacturing the volute spring (patent pending) is said to increase materially both its shock-absorbing ability and effective life. These results are accomplished by improved

Holland Style A-7-A volute snubber spring

surface and depth hardness of the spring material and effective compensation for surface wear by means of radially elastic pressures on inner coils confined within an elastically yielding outer coil.

Tests conducted by the Association of American Railroads with the Holland Style A-7-A volute snubber during 1949 indicated a notable improvement over test results with the Style A-7 snubber in 1948. Comparative figures covering the latest tests are expected to be released soon in official A.A.R. reports.

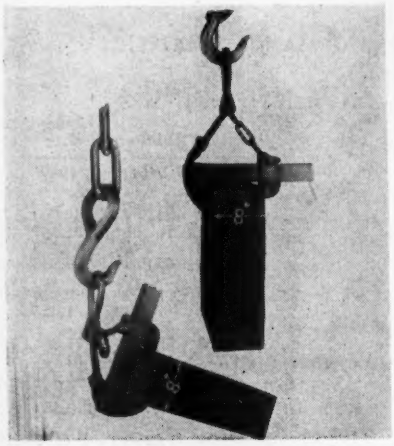
The principle of the Holland snubber spring is a volute spring, coiled tightly under pressure so that the rubbing of the spring turns on each other acts to damp out the vertical resonant action of bolster truck springs. From its inception, it

has been a self-contained unit, designed to replace one coil of the standard spring in freight car trucks.

Movable Grip Jaw Lifting Clamp

The Adjusta-Clamp is a versatile device for moving all types of heavy metal loads in tool rooms, production and shipping departments.

The unit features the advantage of a



movable gripping jaw that can be rapidly set by hand to accommodate the part to be lifted. It will lift from the horizontal to a vertical position without changing the grip.

This tool, which will handle metal objects up to 12 in. thick, is available from Merrill Brothers, 56-02 Arnold Avenue, Maspeth, N. Y. It is manufactured in one- and three-ton capacities, both with a safety factor of 5 to 1 and weigh 30 and 60 lb., respectively. Larger capacities can be supplied on order.

Strain Indicator

A new Type L portable, battery-powered strain indicator for use with SR-4 bonded resistance wire strain gauges is announced by The Baldwin Locomotive Works, Philadelphia 42, Pa. The new instrument is a refinement of Baldwin's Type K instrument.

Four major improvements have been made in this direct reading instrument. First, the ten "Thousands" steps are increased from 1,000 to 2,000 microinches per inch per step, giving a total of 20,000 microinches per inch. This improves the convenience of the instrument and minimizes the use of the range extender switch. Accuracy is unaffected because the scale on the balance indicator dial is unchanged.

Second, the range extender has been increased from an approximate 10,000 microinches to a more exact 20,000 microinches with an accuracy within plus or minus 50 microinches. This change extends the balancing range of the in-

strument to plus or minus 30,000 microinches, which is broad enough to cover all practical applications of SR-4 strain gauges. The broader range of this instrument permits measurements in the plastic range of metals and balancing the bridge when dummy gauges are unusually far off balance.

Third, the new model can be used with a completely external Wheatstone bridge circuit without modifying the internal circuit. This can be done by changing connections X and Y on the instrument binding posts.

The fourth change is the provision of an oscilloscope connector jack for applications in rephasing problems sometimes encountered when using extremely long leads (50 to 100 ft.) between SR-4 strain gauges and the instrument. This connector can also be used for limited dynamic studies because the jack is connected into the amplifier section of the instrument and will permit pre-amplification of the strain gauge signal so that it can be read on a standard oscilloscope.

Measuring acuracy has also been improved. The "Thousands" steps have a tolerance of plus or minus 2½ microinches per inch. Slidewire tolerance is plus or minus 5 microinches per inch and the gauge factor adjustment is accurate to plus or minus ¼ per cent at any point.

The instrument is designed and calibrated for 120-ohm gauges with gauge factors of 1.77 to 2.20. However, gauges of other resistances and gauge factors may be used if necessary. An a.c.-d.c. converter is available for operating the indicator on 110-volt, 60-cycle, single-phase electric power when required for continual operation. The instrument dimensions are 6 x 9 x 12 in., and it weighs about 25 lb. with batteries.

Non-Lubricated Flexible Coupling

The Airflex coupling has been developed to protect driving and driven machinery from the destructive effects of frequent high-torque fluctuations associated with internal combustion engines, reciprocating pumps and reciprocating compressors.

This coupling, manufactured by The Falk Corp., Milwaukee 8, Wis., cushions impact and reduces torque fluctuations by virtue of its resilience. It has high hysteresis without backlash, imparting a high degree of damping to vibratory systems.

These devices are suited for drives with fluctuating torque, those requiring flange or flywheel mounting, drives located where maintenance and lubrication is impossible or where backlash is prohibited.

The construction features of the couplings include a resilient rubber gland, consisting of an inner fluid container and outer section banded as a unit; an inner fluid container treated to prevent pressure loss; a steel inner rim permanently banded to the gland; a steel outer rim with an extended flange to allow bolting to a flywheel or adapter and a specially designed Schrader valve.

NEWS

Chicago Diesel Club Elects New Officers

At the 1950 annual meeting of the Chicago Railroad Diesel Club on June 8, the following new officers were elected to serve for the coming year: President, W. L. Huebner, division master mechanic, Atchison, Topeka & Santa Fe, at Chicago; first vice-president, O. P. Jones, division master mechanic, Chicago & North Western, at Chicago; second vice-president, F. T. Kuhns, general foreman, Chicago, Milwaukee, St. Paul & Pacific, at Chicago; third vice-president, H. W. Rasor, master mechanic, New York Central, at Chicago; secretary-treasurer, R. J. Hughes, mechanical department, C. & N. W., at Chicago.

Central Research Laboratory Dedicated

The new Central Railroad Research Laboratory of the Association of American Railroads was formally opened in Chicago on May 26 before an audience of more than one hundred. Present were directors of the A.A.R. and general committee members of its Engineering, Mechanical, and Operation-Transportation divisions. Others in the audience included representatives of various railroad associations, members of the board of trustees of Illinois Institute of Technology and representatives of the faculty.

Following an informal luncheon in the new building's conference room, William T. Faricy, president of the A.A.R., called the group to order for the formal dedication. Seated in the yet-unequipped mechanical engineering laboratory, the group heard Mr. Faricy outline the program of continuous research which has underlain the growth and development of America's railroad industry. "The net results," he said, "we see all around us, in a railroad plant and railroad methods which today are producing more service and better service than the pioneers could have dreamed of, and are doing it at costs which, in relation to wages and other prices, are far below anything they could have thought possible."

An open house inspection of the building was conducted by members of the research staff following the ceremony. The inspection permitted those present to see some of the equipment which already has been installed and to watch informal demonstrations of some of the more spectacular devices, particularly in the electrical laboratory. Among the construction projects yet to be completed is an inclined test track which will be located immediately west of the building adjacent to the New York Central-Rock Island main line.

Individual research projects which are administered by the laboratory's staff are divided among the Engineering, Mechanical, Refrigerator Car, Container and Sanitary divisions of its personnel. In addition to functioning as a research facility, the container testing laboratory, located on the first floor, will be utilized as a training ground for necessary railroad and Railway Express Agency personnel. Later

SELECTED MOTIVE POWER AND CAR PERFORMANCE STATISTICS

Freight Service (Data from I.C.C. M-211 and M-240)

Item No.		Month of February 1949	Month of February 1948	2 months ended with February 1949	2 months ended with February 1948
3	Road locomotive miles (000) (M-211):				
3-05	Total, steam	21,902	34,853	49,299	73,331
3-06	Total, Diesel-electric	14,696	10,181	29,897	21,023
3-07	Total, electric	678	794	1,443	1,724
3-04	Total, locomotive-miles	37,278	45,829	80,642	96,079
4	Car-miles (000,000) (M-211):				
4-03	Loaded, total	1,249	1,402	2,619	2,907
4-06	Empty, total	661	788	1,455	1,664
6	Gross ton-miles-cars, contents and cabooses (000,000) (M-211):				
6-01	Total in coal-burning steam locomotive trains	30,108	53,792	71,093	113,220
6-02	Total in oil-burning steam locomotive trains	10,732	14,161	21,000	29,307
6-03	Total in Diesel-electric locomotive trains	41,038	28,693	82,801	58,944
6-04	Total in electric locomotive trains	1,658	2,086	3,645	4,466
6-06	Total in all trains	83,543	98,736	178,553	205,948
10	Averages per train-mile (excluding light trains) (M-211):				
10-01	Locomotive-miles (principal and helper)	1.04	1.06	1.04	1.06
10-02	Loaded freight car-miles	37.00	34.60	36.10	34.30
10-03	Empty freight car-miles	19.60	19.50	20.00	19.60
10-04	Total freight car-miles (excluding caboose)	56.60	54.10	56.10	53.90
10-05	Gross ton-miles (excluding locomotive and tender) (000)	2,479	2,440	2,458	2,427
10-06	Net ton-miles (000)	1,079	1,121	1,076	1,115
12	Net ton-miles per loaded car-mile (M-211)	29.10	32.40	29.90	32.50
13	Car-mile ratios (M-211):				
13-03	Per cent loaded of total freight car-miles	65.40	64.00	64.30	63.60
14	Averages per train hour (M-211):				
14-01	Train miles	17.20	16.60	17.20	16.50
14-02	Gross ton-miles (excluding locomotive and tender) (000)	42,103	39,914	41,710	39,656
14	Car-miles per freight car day (M-240):				
14-01	Serviceable	38.30	42.20	38.80	41.80
14-02	All	35.40	40.20	35.90	39.90
15	Average net ton-miles per freight car-day (000) (M-240)	675	833	689	824
17	Per cent of home cars of total freight cars on the line (M-240)	51.90	48.30	51.40	47.60

Passenger Service (Data from I.C.C. M-213)

Item No.		Month of February 1949	Month of February 1948	2 months ended with February 1949	2 months ended with February 1948
3	Road motive-power miles (000):				
3-05	Steam	8,956	16,171	21,332	35,006
3-06	Diesel-electric	12,987	10,512	27,108	22,229
3-07	Electric	1,446	1,587	3,108	3,403
3-04	Total	23,389	28,289	51,548	60,674
4	Passenger-train car-miles (000):				
4-08	Total in all locomotive-propelled trains	231,368	259,364	500,640	557,813
4-09	Total in coal-burning steam locomotive trains	43,097	87,332	104,900	189,435
4-10	Total in oil-burning steam locomotive trains	32,757	39,970	70,109	87,387
4-11	Total in Diesel-electric locomotive trains	139,574	114,415	291,548	243,490
12	Total car-miles per train-miles	9.57	9.02	9.45	9.08

Yard Service (Data from I.C.C. M-215)

Item No.		Month of February 1949	Month of February 1948	2 months ended with February 1949	2 months ended with February 1948
1	Freight yard switching locomotive-hours (000):				
1-01	Steam, coal-burning	1,187	1,988	2,610	4,235
1-02	Steam, oil-burning	209	286	436	607
1-03	Diesel-electric[1]	2,102	1,742	4,394	3,620
1-06	Total	3,522	4,041	7,489	8,515
2	Passenger yard switching hours (000):				
2-01	Steam, coal-burning	57	103	127	219
2-02	Steam, oil-burning	12	16	26	35
2-03	Diesel-electric[1]	205	183	434	396
2-06	Total	305	335	653	710
3	Hours per yard locomotive-day:				
3-01	Steam	6.90	9.30	7.10	9.40
3-02	Diesel-electric	17.30	18.10	17.10	17.90
3-05	Serviceable	13.40	13.70	13.50	13.70
3-06	All locomotives (serviceable, unserviceable and stored)	10.90	11.80	11.00	11.80
4	Yard and train-switching locomotive-miles per 100 loaded freight car-miles	1.93	1.99	1.96	2.02
5	Yard and train-switching locomotive-miles per 100 passenger train car-miles (with locomotives)	0.82	0.80	0.81	0.79

[1] Excludes B and trailing A units.

this summer, the staff of a sanitation research engineer will be moved to quarters in the new building, and this group will undertake studies of both manufacturing facilities and equipment in the development of approved standards in sanitation.

Many of the projects currently being undertaken by the Engineering division of the laboratory are primarily for the A.A.R.'s Construction & Maintenance section (American Railway Engineering Association). Continued research in rail detector car improvements, rail design studies, development of a brine corrosion inhibitor, tests of rail anchorage, a study of impacts and bridge stresses and many other similar projects are under way.

The Mechanical division is currently studying alloy-steel axles, roller-bearing lubricants, truck side-frames and bolsters, freight trucks and snubbers, metal running boards and a number of other appliances, some of which are aimed at a revision of current A.A.R. specifications.

One of the most important projects now being undertaken by the Refrigerator Car division is a detailed study of the possible application of pallets and power lift trucks to refrigerator car loading. This project involves consideration of car-door changes, to permit entry of power trucks, and a change in flooring specifications to accommodate the additional weight. Studies will also be undertaken on refrigerator car clearances, and elevations, loading ramps and methods of fastening commodities within cars. Work is being continued on the discovery and application of better insulation materials as well as on the most economical application of new refrigeration systems.

A considerable amount of the research work carried on by the divisions of the A.A.R. is of course, done in established educational institutions such as Purdue and Northwestern universities, the Battelle Memorial Institute at Columbus, Ohio, and the University of Illinois. The Central Research Laboratory will serve as an administrative "nerve center" for all work undertaken for the A.A.R. at the universities and at the laboratories of railroad suppliers and the carriers themselves. At the same time, the laboratory itself will be the scene of many important studies and experiments. It will further function as a center and maintenance and design for the testing of equipment used in research at all points.

MISCELLANEOUS PUBLICATIONS

"Running a Regal."—R. K. LeBlond Machine Tool Company, Cincinnati 8, Ohio. 8½-in. by 11-in. manual, wire bound; 92 pages. Price, 50 cents. This completely revised fourteenth edition of "Running a Regal" contains, for the first time, an exploded parts section, in which each part of the Regal is illustrated in proportion and relation to connecting or adjacent parts. Instructions are given for performing 24 of the most common lathe operations, such as centering work, facing to length, tapping, lapping, taper turning and boring, etc. The operating, lubrication, and maintenance of the lathe; measuring instruments, and lathe tools and how to grind them are also discussed.

ORDERS AND INQUIRIES FOR NEW EQUIPMENT PLACED SINCE THE CLOSING OF THE JUNE ISSUE

DIESEL LOCOMOTIVE ORDERS

Road	*No. of Units*	*Horse-power*	*Service*	*Builder*
Baltimore & Ohio	34[1]	1,500	Freight	Electro-Motive
Bessemer & Lake Erie	7A	1,500	Road	Electro-Motive
	7B	1,500	Road	Electro-Motive
	5	1,500	Road switch	Baldwin
Boston & Maine	4[2]	1,500	Freight	Electro-Motive
	8[2]	1,500	Road switch	Electro-Motive
	8[2]	1,000	Switch	Alco-G. E.
	4[2]	660	Switch	Alco-G. E.
Central of Georgia	2[3]	2,000	Passenger	Electro-Motive
	2[3]	1,500	Switching	Electro-Motive
	3[3]	1,500	Switching	Alco-G. E.
Chesapeake & Ohio	5[4]	1,200	Switching	Gen. Motors Diesels, Ltd.
	16[4]	1,500	Road switch	Gen. Motors Diesels, Ltd.
Chicago, Rock Island & Pacific	12	1,500	Road switch	Electro-Motive
	1	2,250	Passenger	Electro-Motive
	3	800	Switching	Electro-Motive
	2	800	Switching	Lima-Hamilton
	2	1,000	Switching	Davenport Besler
Clinchfield	6[5]	1,200	Switching	Electro-Motive
Delaware & Hudson	18[6]	1,000	Switching	Alco-G. E.
	16[6]	1,500	Road switch	Alco-G. E.
Gulf, Mobile & Ohio	4B	1,600		Alco-G. E.
	4	1,600	Road switch	Alco-G. E.
	4B	1,500		Electro-Motive
Maine Central	8[7]	1,500	Road switch	Electro-Motive
	3[7]	1,200	Switching	Electro-Motive
	2[7]	1,000	Switching	Alco-G. E.
Missouri-Kansas-Texas	6[8]	1,500	Passenger	Alco-G. E.
	2[8]	1,600	Road switch	Alco-G. E.
	8[8]	1,600	Road switch	Baldwin
Nashville, Chattanooga & Tennessee	16	1,500	Road	Electro-Motive
	17	1,500	Road-switch	Electro-Motive
	10	1,200	Switching	Electro-Motive
Texas & Pacific	19[9]	1,500	Freight	Electro-Motive
	4[9]	1,200	Switching	Electro-Motive

FREIGHT-CAR ORDERS

Road	*No. of cars*	*Type of car*	*Builder*
Bangor & Aroostook	300[10]	Comb. paper and insulated heater	Major Car
Missouri-Kansas-Texas	100[11]	70-ton covered hopper	Pullman-Standard

FREIGHT-CAR LEASES

Green Bay & Western	200[12]	50-ton box	Pullman-Standard

FREIGHT-CAR INQUIRIES

Akron, Canton & Youngstown	150	50-ton box
Gulf, Mobile & Ohio	200	50-ton automobile
Kansas City Southern	100	50-ton automobile
	300	50-ton box
Southern	300	70-ton covered hopper

PASSENGER-CAR ORDERS

Road	*No. of cars*	*Type of car*	*Builder*
Pennsylvania-Reading Seashore Lines	6[13]	Rail Diesel	Budd Co.

[1] For delivery next year. These units will be used to complete Dieselization of through freight service on the road's Buffalo division, at which time B. & O. freight service will be Dieselized from Benwood, W. Va., to Buffalo, N. Y., and Rochester, via Pittsburgh, Pa., Riker and East Salamanca, N. Y. Present arrangements contemplate purchase of the new units through a conditional sales agreement.

[2] Delivery is scheduled to begin in July and be completed in early autumn. Six of the 1,500-hp. road-switching and two of the 1,000-hp. switching units will be used to complete Dieselization of the road's territory north of Concord, N. H., including the White River Junction yard. Other units will be assigned to pool service on Rockport, Mass.-Salem local freight and Boston, Mass.-Rockport passenger service as well as to Salem yard and Salem-Amesbury local freight. Two 1,000-hp. and one 660-hp. yard switching units will be used in the Boston yards. "In addition to annual savings in operating costs we will be able to retire 35 steam locomotives," a spokesman for the road has said. "When these additional units are placed in service we will be handling about 98 per cent of our freight ton-miles by Diesels."

[3] Delivery expected in July. These units increase the road's total of Diesel units in service to 56.

[4] The switchers are scheduled for delivery in October and the road-switchers in the first quarter of 1951. The units will be used to Dieselize completely the Canadian division of the Pere Marquette district.

[5] Delivery expected in July.

[6] To be purchased through a conditional sale agreement.

[7] Deliveries expected during August and September.

[8] Delivery scheduled for completion by September.

[9] For delivery late in September.

[10] To cost approximately $600,000.

[11] To be leased under Equitable Life Assurance Society's rental program. For October delivery.

[13] Total approximate cost $800,000. Delivery of the equipment is expected to be completed in October. Purchase by this road of six additional cars of the same type, to be delivered before the summer of 1951, has been ordered by New Jersey Board of Public Utility Commissioners in lieu of reconditioning 20 old cars. The board's order originally called for modernization of 60 old cars, of which 40 will be ready for service by July 1.

NOTES:

Baltimore & Ohio.—The B. & O. has announced that tentative arrangements are being made to obtain 10 Fairbanks-Morse Diesel-electric switching locomotives under the Equitable Life Assurance Society's rental program.

Chicago & Eastern Illinois.—The C. & E. I. has received authority from its board of directors to purchase 200 box cars at an estimated cost of $1,000,000.

New York Central.—The N. Y. C. has completed arrangements for leasing from the Equitable Life Assurance Society the 1,500 50-ton, 40½-ft. steel box cars ordered earlier this year from the Pullman-Standard Car Manufacturing Company (see March issue, page 172).

Union Pacific.—The U. P. has earmarked $36,000,000 of its $190,000,000 1950 improvement program for new equipment, including 8,000 new or modernized freight cars, 65 new sleeping cars, 36 Diesel-electric locomotives and a fleet of new coaches. Orders by the U. P. for 35 Diesel-electric locomotive units costing $4,875,000 and 4,500 freight cars costing about $23,000,000 have been reported in the *Railway Mechanical and Electrical Engineer* so far this year.

SUPPLY TRADE NOTES

DEARBORN CHEMICAL COMPANY.—The Dearborn Chemical Company has assigned 12 new representatives to its sales and service staff in the following territories, with headquarters as indicated: *T. Armstrong*, west Texas and New Mexico, at Amarillo, Tex.; *R. W. Bartlett*, New England, at Boston, Mass.; *C. P. Blakeley*, New Jersey, at New York; *T. Bull*, northern California, at San Francisco; *J. W. Fisher*, eastern Ohio, at Cleveland; *R. E. Johnson*, northern part of Chicago; *W. J. Mercier*, southern Wisconsin, at Milwaukee; *R. T. Moran*, part of Michigan, at Kalamazoo; *D. E. Pedginse*, northern Indiana, at South Bend, and *H. O. Scott*, central Ohio, at Dayton. Assigned to Dearborn's technical department in Chicago are *V. P. Nobile*, as assistant to the manager of the industrial water treatment department, and *K. W. Franks*, as assistant to the technical director of the railroad department.

◆

UNION CARBIDE & CARBON CORP.—*A. S. Johnson* has been appointed general manager of the National Carbon Division of the Union Carbide & Carbon Corp., New York. Mr. Johnson has been a vice-president of the corporation since 1948.

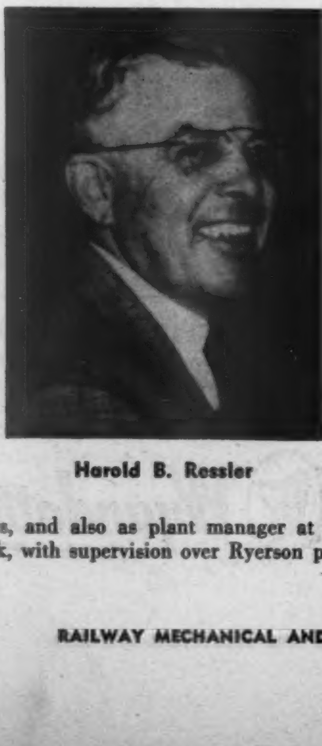
◆

COMBUSTION ENGINEERING-SUPERHEATER, INC.—The New York office of the *Superheater Company*, Division of Combustion Engineering-Superheater, Inc., has been removed to 200 Madison Avenue, Zone 16. The Chicago office has been moved to Bankers building, Zone 3.

◆

JOSEPH T. RYERSON & SON.—*Harold B. Ressler*, formerly vice-president and general manager of sales of Joseph T. Ryerson & Son, has been elected first vice-president; *C. L. Hardy*, formerly assistant vice-president, has been appointed assistant to the president; and *Thomas Z. Hayward*, formerly assistant general manager of sales, has been appointed general manager of sales.

Mr. Ressler served as manager of the St. Louis, Mo., plant for a number of



Harold B. Ressler

years, and also as plant manager at New York, with supervision over Ryerson plants at Boston, Mass., Philadelphia, Pa., and Buffalo, N. Y. He has held the positions of vice-president and general manager of sales since 1932, with headquarters at Chicago since 1944.

Mr. Hardy joined Ryerson's Boston plant in 1927, working successively in plant operations, inside sales, and sales representative in Boston and New England. He was appointed manager of the Philadelphia

C. L. Hardy

plant in 1949, later transferring to the Chicago plant as assistant vice-president, in which capacity he served as an executive in procurement and sale of certain products.

Mr. Hayward joined the sales department of Ryerson in 1917 and for a number of years was sales representative in Chicago. In 1936 he was appointed assistant

Thomas Z. Hayward

sales manager of the Chicago plant and in 1938 manager of the tubular products division. He became assistant general manager of sales in 1944.

Roland W. Burt has been appointed sales manager of the Chicago plant of Ryerson & Son, to succeed Mr. Hayward. Mr. Burt began his career with Ryerson in 1923. He was appointed sales representative in northern Indiana in 1926 and remained there until 1937 when he was transferred to the St. Louis, Mo., plant as a representative of the railroad sales division. The following year he was appointed eastern manager of railroad sales, with headquar-

Roland W. Burt

ters at New York. In 1945 Mr. Burt returned to Chicago as head of the Ryerson tubular products division.

◆

BLACK & DECKER MANUFACTURING COMPANY.—*Robert A. Brown*, who has been service engineer at the Cincinnati, Ohio, factory service station of Black & Decker, has been appointed sales engineer in the Atlanta branch territory. Mr. Brown will work with distributors of Black & Decker, Van Dorn and Home-Utility electric tools in the northern part of Georgia and eastern Tennessee area. *George H. Thalman, Jr.*, will assume Mr. Brown's duties at Cincinnati, being in charge of all repair activities at this location. *Wm. F. Dunn, Jr.*, formerly service engineer at the New Orleans, La., branch has been appointed sales engineer in that territory. *Grady R. Funk*, service engineer at Charlotte, N. C., succeeds Mr. Dunn as service engineer at New Orleans. *Robert Dawson* has become a sales engineer under the supervision of *W. L. Poynter*, Kansas City, Mo., branch manager. Mr. Dawson will cover the Nebraska and western South Dakota region.

◆

ALUMINUM COMPANY OF AMERICA.—The Aluminum Company of America has assumed manufacturing activities of its subsidiary, the American Magnesium Corporation, and the latter corporation has become inactive. Operations of American Magnesium at Cleveland, Ohio, and Buffalo, N. Y., will be continued under Alcoa management. *Robert T. Wood* has been appointed chief metallurgist of magnesium products for the Aluminum Company. He was formerly chief metallurgist for American Magnesium.

Effective August 1, *Dr. Kent R. Horn* will become associate director of research for the Aluminum Company.

◆

THOMAS A. EDISON, INC.—*Charles Edison*, president of Thomas A. Edison, Inc., for the past 24 years, has been elected to the newly created position of chairman of the board of directors, and *Henry G. Riter, III*, has been elected to succeed Mr. Edison as president.

AMERICAN CAR & FOUNDRY CO.—*Edmund A. Watson* has been appointed general improvement engineer of the American Car & Foundry Co., succeeding *John W. Sheffer*, who has retired after 42 years service with the company.

Mr. Watson has been in plant engineering and production methods work since 1915. In 1940 he was instrumental in the conversion of the Buffalo, N. Y., plant of

Edmund A. Watson

American Car & Foundry to the manufacture of artillery shells for the British and, later, the American armed forces. He remained there as production manager until 1946 when he was appointed assistant general improvement engineer, with headquarters in New York.

◆

TIMKEN ROLLER BEARING COMPANY.—*J. W. Thomas*, formerly sales engineer, railway division, of the Timken Roller Bearing Company, at Chicago, has been appointed sales engineer, railway division, at the St. Louis, Mo., office, and *Glenn E. Neal* has been appointed to succeed Mr. Thomas at Chicago.

◆

FAIRBANKS, MORSE & CO.; CANADIAN FAIRBANKS-MORSE COMPANY.—Fairbanks, Morse & Co. and the Canadian Fairbanks-Morse Company are entering the Canadian railroad Diesel locomotive manufacturing field by purchasing a substantial stock interest in the *Canadian Locomotive Company* of Kingston, Ont. The Canadian Locomotive Company, founded 100 years ago, will be operated as a separate concern and its products will continue under the same name.

◆

YALE & TOWNE MANUFACTURING CO.—*Elmer F. Twyman* has been elected vice-president in charge of the Philadelphia, Pa., division of the Yale & Towne Manufacturing Co., to succeed *James C. Morgan*, who has retired. *John A. Baldinger*, assistant general manager of the Automatic Transportation Company division of Yale & Towne, has been transferred to the Philadelphia division as assistant general manager of the Philadelphia plant.

◆

KENNAMETAL, INC.—*Thomas J. Kniff, Jr.*, has been appointed representative of Kennametal, Inc., at 11 West Forty-Second street, New York, and Fred Moore, representative in the Central district, with headquarers at 5531 Woodward avenue, Detroit, Mich.

DAYTON RUBBER COMPANY.—*E. K. Lofton*, formerly sales manager, railway division, of Dayton Rubber Company, has been appointed regional manager, Dayton region, at Dayton; *J. W. Torrant*, formerly district manager at Boston, Mass., has been appointed regional manager, Chicago region, 1009 West Washington boulevard, Chicago; *T. J. Ehrhart*, formerly district manager, Dallas, Tex., has been appointed regional manager, Dallas region, at 2805-15 Canton street, Dallas; *A. L. Van Der Kar*, formerly with the Ansco division of General Aniline & Film Corp., has been appointed regional manager, New York region, at Harborside terminal, Jersey City, N. J., and *M. E. Runner*, formerly district manager, Los Angeles, Calif., district, has been appointed regional manager, Los Angeles region, at 909 E. Slauson avenue, Los Angeles.

◆

LAMSON & SESSIONS COMPANY.—*George S. Case, Jr.*, has been elected president of the Lamson & Sessions Co., and *Robert G. Patterson*, vice-president and general sales manager.

Mr. Patterson joined the company in 1935 to organize the automotive replace-

Robert G. Patterson

ments division. He was appointed merchandising manager and, later, general sales manager. He was elected a director in 1945 and appointed vice-president and general sales manager in 1948. Mr. Patterson also operates the Piston Service Company of Indianapolis, Ind.

◆

GENERAL MOTORS CORPORATION, ELECTRO-MOTIVE DIVISION.—A tour of the Diesel-locomotive plant at LaGrange, Ill., and a dinner at the Stevens Hotel, Chicago, at which C. E. Wilson, president of General Motors, was the principal speaker, featured the formal opening of the Electro-Motive Division's exhibit at its plant titled "Blueprint for Better Locomotives," on June 13. The occasion marked also the attainment of a production rate of 200 Diesel units a month in March. Some 500 railroaders, newspaper men and business and civic leaders heard Mr. Wilson explain the five-year labor contract which General Motors recently negotiated with the representatives of its employees.

The permanent exhibit is housed in a large room, 120 ft. x 60 ft. It comprises principally symbol explanations and working models of E. M. D.'s methods of design, manufacture, distribution and servicing. Among the exhibit groups are a mock-up cab of the company's latest high speed passenger locomotive, the E-8, complete with all controls and cab appurtenances.

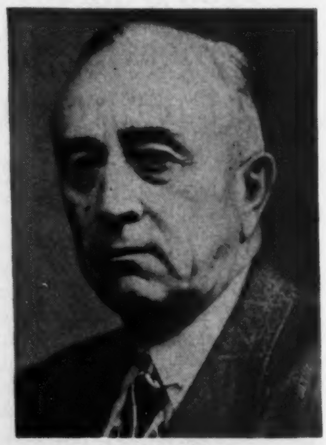
Separate exhibit groups include: (1) "planned Dieselization for maximum economy"; (2) service department, including field organization, methods, instructions, and maintenance scheduling; (3) contrast between old and new ways of carrying out various production phases at E. M. D.; (4) repair services by E. M. D.; (5) the work of the company's public relations staff in "selling enthusiasm for railroad trains"; (6) distribution of parts; (7) continuous engineering development; (8) production control and purchasing; and (9) inspection.

◆

GENERAL STEEL CASTINGS CORPORATION.—*John A. McCormick*, district manager of sales in charge of the Chicago office of the General Steel Castings Corporation, has been appointed assistant vice-president—sales. Mr. McCormick continues also in charge of the Chicago district sales office. *James W. Cooke*, district manager—sales, in charge of the eastern district sales office at Eddystone, Pa., has been appointed assistant vice-president, and will be associated with W. M. Sheehan, vice-president, in sales promotion and development, working closely with both the sales and engineering departments. Howard F. Park, Jr., assistant district manager—sales at Eddystone, succeeds Mr. Cooke.

◆

EARLE M. HARSHBARGER, who has retired as manager of the railway sales department of SKF Industries, Inc., as announced in the June issue, was born in Ladoga, Ind., on April 14, 1886. He attended Wabash College for one year, Purdue University for two years, and the Central Business College, Indianapolis, Ind., for one year. From 1910 to 1914, he



E. M. Harshbarger

was, successively, farmer, insurance, real estate and auto agent. In 1914 he entered the sales department of S. F. Bowser & Co. at the company's home office, later serving as an outside salesman; for five years as manager of the company's railroad department; and for two years as district manager at New York. In 1926 he became engaged in sales work for SKF Industries, and in 1930 was appointed manager of railroad sales.

Automatic Transportation Company.—*Lawrence J. Kline* has been appointed sales manager of the Automatic division of the Automatic Transportation Company, Chicago, to direct sales activities for Automatic and Skylift trucks. Mr. Kline was formerly executive vice-president of the Mercury Manufacturing Company, Chicago.

◆

Fate-Root-Heath Company—*Robert H. Schleuning*, Pittsburgh, Pa., has been appointed sales representative for switching locomotives and other products of the Plymouth locomotive works division of the Fate-Root-Heath Company, Plymouth, Ohio. Mr. Schleuning, who will operate in western Pennsylvania and New York, northern West Virginia and parts of Ohio and Maryland, was formerly associated with the Pressed Steel Car Company.

◆

Wilson Engineering Corporation.—The Wilson Engineering Corporation of Chicago has appointed *Don B. Alexander*, Terminal Tower Building, Cleveland, Ohio, eastern representative.

◆

Scullin Steel Company.—*Fred H. Spenner*, formerly assistant vice-president, mechanical engineering, of the Scullin Steel Company, has been appointed vice-president, mechanical engineering.

◆

Metal & Thermit Corp.—The Metal & Thermit Corp. has moved its general offices from 120 Broadway, New York, to 100 East Forty-second street, New York 17.

◆

Black & Decker Manufacturing Co.—*Walter H. Bramman* has joined the sales force of Black & Decker, working with the company's electric tool distributors in the eastern part of Washington as well as in all of Montana and all of Idaho east of Boise. *J. H. Webb*, who covered Mr. Bramman's territory, will now concentrate his services in the Seattle, Wash., area.

Mr. Bramman was previously in the sales department of the Shell Oil Company in Baltimore, Md.

◆

DeVilbiss Company.—The DeVilbiss Company has opened a new assembling, warehousing and distributing plant in Santa Clara, Calif., to serve the territory covered by the company's sales branches in San Francisco, Calif., Los Angeles, and Salt Lake City, Utah.

◆

Hunt-Spiller Manufacturing Corporation.—*A. G. Edgar*, general manager of the Hunt-Spiller Manufacturing Corporation, Boston, Mass., has been elected a vice-president.

◆

Carnegie-Illinois Steel Corporation.—*John F. Schmitt* and *J. Gardner Brooks*, heretofore salesmen for Carnegie-Illinois Steel Corporation (subsidiary of the United States Steel Corporation) at Chicago and Pittsburgh, Pa., respectively, have been appointed assistants to manager of Chicago district railroad sales.

Arcos Corporation.—*Bernard E. David* has been appointed a special field engineer for the Arcos Company at Los Angeles, Calif. *Walter Gordon List* will act as a special field engineer in Ohio-Western Pennsylvania territory, assisting Williams & Co. of Pittsburgh, Pa., in the sale of Arcos electrodes. *J. J. Schlass* has been appointed a sales representative in the Philadelphia, Pa., district. The company also plans to establish a modern manufacturing plant at Somerset, Pa.

◆

Inland Steel Company.—*Robert M. Buddington*, assistant to manager of sales, sheet and stripping division, of Inland Steel Company, has been appointed assistant manager of sales of that division, succeeding *William P. Burke*, resigned.

◆

General Electric Company.—*Norman W. Seip* has been appointed sales manager, parts division, of the General Electric Company's locomotive and car equipment divisions at Erie, Pa. Mr. Seip was born in Chicago and is a graduate of the University of Illinois. He entered the test course of G. E. in August, 1940, and in October, 1944, transferred to the transportation division. In July, 1945, he moved to the St. Louis, Mo., office, where he was transportation sales engineer at the time of his appointment as sales manager, parts division.

Norman W. Seip

◆

Vanadium Corporation of America.—*Raymond H. Filsinger, Jr.*, formerly eastern sales representative for the Vanadium Corporation of America, has been appointed sales manager, eastern district, with headquarters at 420 Lexington avenue, New York 17.

Mr. Filsinger, a graduate of Bard College in 1938 with a B. A. degree, joined the sales department of Vanadium in 1939. From 1942 to 1946 he served in the United States Army as captain in the Quartermaster Corps. In the latter year he returned to Vanadium and in 1947 was appointed eastern sales representative.

◆

Griffin Wheel Company.—*Howard F. Tway* has been appointed sales representative of the Griffin Wheel Company, with headquarters at Kansas City, Kan.

Vapor Heating Corporation.—*T. A. Stewart, Jr.*, formerly in charge of service activities for Vapor Heating Corporation at Portland, Ore., has been transferred to St. Paul, Minn., where he will have charge of service activities for territory comprising Minnesota, Iowa, Wisconsin, North Dakota, South Dakota, Montana, Idaho and eastern Washington. He is succeeded at Portland by *C. J. Mulvena*.

◆

Hyman-Michaels Company.—*William Page*, formerly in the railroad car parts department of the Hyman-Michaels Company, Chicago, has been appointed a vice-president.

◆

Glidden Company.—*L. S. Fulton* has been appointed manager of the West Coast paint division of the Glidden Company to succeed *Z. G. Peck*, who has retired after 30 years of service. Mr. Fulton has been associated with the company since 1920 and formerly was assistant to the president and regional director of the St. Louis, Mo., division.

◆

Alloys Development Company.—The offices of the Alloys Development Company and *Frederick D. Foote* have been removed to 2537 Koppers building, Pittsburgh 19, Pa.

◆

United States Steel Products Company.—*Thomas M. Stinson*, formerly district sales manager in the St. Louis, Mo., territory for the *United States Steel Producs Company*, a U. S. Steel Corporation subsidiary, has been appointed general manager of sales, with headquarters at 30 Rockefeller Plaza, New York. He is succeeded by *G. P. Wardley, Jr.*, formerly a sales representative at the Bennett manufacturing division, Chicago.

◆

Baldwin Locomotive Works.—*Raymond B. Crean*, assistant vice-president of the Baldwin Locomotive Works, has been elected vice-president in charge of apparatus sales—Eddystone division.

◆

Thomas C. Wilson, Inc.—Thomas C. Wilson, Inc., Long Island City, N. Y., has purchased the safety release pressure bolt business of *Dunton-Chambers Manufacturers*, New York. The company will combine the manufacture of the new safety release pressure bolt with their line of tube expanders and tube cleaners and market the new line under the name of Wilson-Dunton.

◆

Hyster Company.—The Hyster Company has appointed two new district managers of lift truck, turret truck, straddle truck and mobile crane sales. *D. Stearns* will handle sales in Pennsylvania, New Jersey, Virginia, West Virginia and the District of Columbia, while *W. M. Costley* will be in charge of territory comprising Minnesota, Wisconsin, northern Illinois, Iowa, eastern Nebraska, North and South Dakota, and eastern Montana. Mr. Costley formerly was regional sales supervisor in the Chicago area for the Clark Equipment Company.

D. W. Onan & Sons, Inc.—D. W. Onan & Sons, Inc., Minneapolis, Minn., has appointed the *Nelson Equipment Company*, Portland, Ore., as Onan distributors in Oregon and several counties in Idaho. The *T. C. Johnson Company*, 923 Midland building, Cleveland 15, Ohio, has been appointed railroad representative to handle all sales to railroads having headquarters in the Cleveland area.

Obituary

F. B. Hartman, 75, retired southeastern representative of the Hunt-Spiller Manufacturing Corporation, died on June 4, at Cincinnati, Ohio, after a short illness.

◆

T. O. Sechrist, vice-president of the Hanna Stoker Company since December, 1948, died on April 2, at Louisville, Ky., after a long illness. Mr. Sechrist formerly was associated with the Louisville & Nashville for 34 years, and at the time of his retirement from that road in January, 1948, was assistant superintendent of machinery.

PERSONAL MENTION

General

T. J. Lyon, superintendent of equipment of the New York Central at New York, has assumed jurisdiction over the electric equipment department in the New York territory and the West Springfield (Mass.) Diesel shop.

◆

John P. Morris, assistant to operating vice-president of the Atchison, Topeka & Santa Fe at Chicago, has been appointed general manager of the mechanical department, with headquarters at Chicago. Mr. Morris was born on March 16, 1890, at

John P. Morris

Fort Madison, Iowa. He entered railroad service in 1904 as a machine operator for the Santa Fe at Shopton, Iowa, and subsequently served as machinist apprentice, machinist, machinist gang foreman, en-

ginehouse foreman and general foreman. He was appointed master mechanic of the Illinois division in 1924; to mechanical assistant at Chicago in 1937; mechanical superintendent at Shopton in 1938, and general mechanical assistant at Chicago in 1939. He became assistant to operating vice-president in November, 1948.

W. H. Gimson, superintendent of motive power, St. Louis-San Francisco, at Springfield, Mo., has been appointed superintendent of motive power of the Alabama, Tennessee & Northern, with headquarters at Springfield.

F. G. Baker, assistant superintendent of motive power of the St. Louis-San Francisco at Springfield, Mo., has been appointed assistant superintendent of motive power of the Alabama, Tennessee & Northern with headquarters at Springfield.

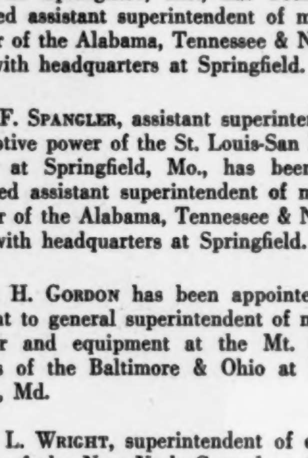
P. F. Spangler, assistant superintendent of motive power of the St. Louis-San Francisco at Springfield, Mo., has been appointed assistant superintendent of motive power of the Alabama, Tennessee & Northern with headquarters at Springfield.

W. H. Gordon has been appointed assistant to general superintendent of motive power and equipment at the Mt. Clare shops of the Baltimore & Ohio at Baltimore, Md.

A. L. Wright, superintendent of equipment of the New York Central at Cleveland, Ohio, has assumed jurisdiction over the Collinwood (Ohio) Diesel shop.

Car Department

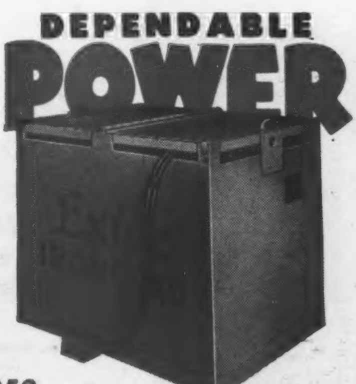
George O. Prosser, whose appointment as superintendent—car department of the Kentucky & Indiana Terminal at Louisville, Ky., was reported in the June issue, was



George O. Prosser

born on December 17, 1900, at Kansas City, Kan. He entered service with the K. & I. T. in July, 1920, and two years later became assistant general car foreman. In 1931 he was appointed to general car foreman.

C. N. Swartwood, supervisor car repairs of the Erie at Jersey City, N. J., has been appointed shop superintendent at Dun-



DEPENDABLE
POWER

more, Pa. The position of supervisor car repairs at Jersey City has been abolished.

L. H. Creighton has been appointed shop superintendent of the Erie, with headquarters at Susquehanna, Pa.

S. G. Daniel, designing draftsman, has been appointed assistant works manager of the car department at the Point St. Charles shops of he Canadian National at Montreal, Que.

E. P. Stemshorn, assistant works manager of the car department of the Canadian National at the Point St. Charles shops, Montreal, Que., has been assigned special duties in the mechanical department at headquarters.

L. E. Schuette, shop superintendent of the Eastern district of the Erie, has been appointed supervisor car repairs, with jurisdiction over the entire system and headquarters as before at Susquehanna, Pa.

L. S. Kurfess, supervisor car repairs of the Erie, has been appointed assistant superintendent car department, with headquarters as before at Cleveland, Ohio. The position of supervisor of car repairs has been abolished.

D. W. Akins, superintendent car department of the Texas & Pacific at Dallas, Tex., has retired after 52 years of railroad service.

Master Mechanics And Road Foremen

J. W. Gann, master mechanic of the Cedar Rapids division of the Chicago, Rock Island & Pacific, has been transferred to the position of master mechanic at Armourdale, Kan.

J. H. Kasmeier, general foreman of the Chicago, Rock Island & Pacific at Cedar Rapids, Iowa, has been appointed master mechanic, with headquarters at Chicago.

L. B. Close, master mechanic, Chicago division, of the Chicago, Rock Island & Pacific, at Chicago, has been transferred to the position of master mechanic at Little Rock, Ark.

M. L. Harbour has been appointed road foreman of engines of the Kansas City division and the Third and Burlington districts of the Eastern division (including Ottawa Junction) of the Atchison, Topeka & Santa Fe, with headquarters at Argentine, Kan.

W. C. Ellison, division master mechanic of the Gulf, Colorado & Santa Fe, at Galveston, Tex., has been appointed master mechanic of the Atchison, Topeka & Santa Fe's Pecos division, at Clovis, N. M.

Clifford E. Gainer, assistant master mechanic of the Baltimore & Ohio at Cumberland, W. Va., has been appointed master mechanic at the Glenwood shops, Pittsburgh, Pa.

D. J. Everett, master mechanic of the Kansas City and Eastern divisions of the Atchison, Topeka & Santa Fe at Argentine, Kan., has been transferred to Galveston, Tex. as master mechanic.

William J. Baumiller, master mechanic in the Glenwood, Pa., shops of the Baltimore & Ohio, has been transferred to the position of master mechanic at the Riverside shops in South Baltimore, Md.

Harold F. Mackey, master mechanic of the Atchison, Topeka & Santa Fe, at Clovis, N. M., has been appointed master mechanic of the Kansas City and Eastern divisions, with headquarters at Argentine, Kan.

J. E. Kerwin, master mechanic of the Chicago, Rock Island & Pacific at Armourdale, Kan., has been transferred to Cedar Rapids, Iowa, as master mechanic of the Cedar Rapids division.

Shop and Enginehouse

W. M. Jennings, night foreman at the Roanoke, Va., coach yard shops of the Norfolk & Western, has been appointed day foreman.

A. J. Bennie, assistant foreman in the erecting shop of the Norfolk & Western at Portsmouth, Va., has been promoted to the position of assistant foreman, Portsmouth machine shop.

Ray D. Stone, foreman, tool room, at the Roanoke, Va., shops of the Norfolk & Western, has been appointed assistant machine shop foreman.

Obituary

William H. Sagstetter, who retired in June, 1947, as chief mechanical officer of the Denver & Rio Grande Western at Denver, Colo., died in Denver on May 12. Mr. Sagstetter was born on February 1, 1886, at Wabash, Ind. He attended grade and high school and, through the International Correspondence School, studied mechanical engineering. He started his railroad career as a machinist with the Texas & Pacific, and later served on various roads, including the Guatemala Central; the Costa Rica; the Panama; the Pennsylvania; the Cleevland, Cincinnati, Chicago & St. Louis; the Los Angeles & St. Louis, and the Southern Pacific. From 1907 to 1910 he was employed on the Cananea, Yaqui River & Pacific at Empalme, Sonora, Mex. Mr. Sagstetter then went with the Kansas City Southern, successively serving as general foreman and master mechanic at Shreveport, La., and master mechanic at Pittsburg, Kan. In 1920 he became vice-president of the Pittsburg (Kan.) Boiler & Machine Co. and in 1922 president of the Salt Lake Iron & Steel Co. at Salt Lake City, Utah. In April, 1926, he became general foreman on the Wabash at Delray, Mich., and the following May assistant master mechanic at Montpelier, Ohio. In 1928 he was appointed master mechanic at Decatur, Ill.; in 1932, assistant superintendent motive power at Decatur, and in June, 1937, chief mechanical officer of the D. & R.G.W.